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NOTES AND COMMENTS.

Haeckel.

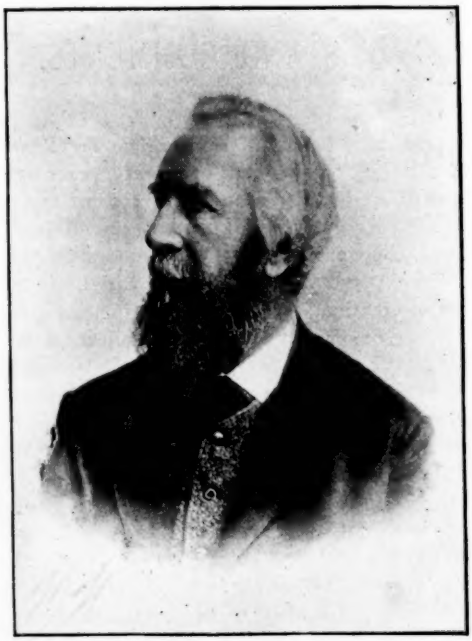
"It gives furiously to think," as the *Saturday Review* delights to put it, that Ernst Haeckel was born only sixty years ago; for those of us whose scientific education dates within the last two decades have been accustomed to regard him as a necessary pillar of the world of thought. Morphology, promorphology, the categories of individuality, the gastræa theory, the comparisons of vertebrate embryos, the natural history of creation, and the blundering incapacity of those who doubted it, were no small part of the intellectual pabulum of our scientific youth. We learned from him that the animal kingdom was a set of pieces to be arranged in orderly procession from Protista to Man; that to study the embryology of an animal was to unwrap an Indian puzzle-box, piece within piece, and each piece suggesting the animal next behind in the procession of all the animals. We learned from him to invent logically hypothetical ancestors, and to find living animals to tally with them. It was all so cogent and so stimulating, and now, with fuller knowledge, so easy to jeer at and discredit. No one goes now to Naples to discover in the development of an animal exactly what he knows should be there: even a new discovery of the ancestor of all the vertebrates is somewhat blown upon. We elaborate methods, work out details, and mutter sadly:—

> "Embryologists we,
> But we haven't got everything down in the sea."

It is a history common to all great ideas. They explain so much at first, open so many new vistas, lead to advances so great that they seem master-keys to all the secrets of nature. And then a time comes when the potent explanation becomes impotent; a time when one set of men seeing only how much it has explained, distort things it cannot explain into formal harmony, while another set, seeing only what it cannot explain, attempt to discredit it altogether. The cell theory and the recapitulation theory are now in this condition, and Haeckel, partly because of the intimate connection of so much of his

work with the recapitulation theory, is, perhaps, less of a moving force in Biology now than ever he has been.

None the less, when the history of the Biological Renaissance comes to be written, the naturalist of Jena will be among the three or four most conspicuous figures. Since Johannes Müller at Berlin, no teacher has turned out so brilliant a set of pupils, has founded so energetic, so militant, so flexible a school. It is astonishing, but only at first sight, that his school should have been so flexible and the paths of his pupils so divergent. For those who have worked in his laboratory and talked with him under the lindens at his fascinating



ERNST HAECKEL, from a photograph by F. Haack, Jena.

combinations of Seminar and Kneipe, know that Haeckel is a man not of one idea, but of ideas. However one may admire patient empirical work, it is not patient empirical work, but patient labour pointed by preconceptions, made alive by ideas, that is stimulating and aggressive, moving towards new branches of investigation. He is a dull man whom all speak well of, and it is dull work that evokes no antagonism. For the present, we are well content to cease from controversy, to let Calcareous sponges, the Gastrula, the "Plankton," and Haeckelismus take care of themselves, and to join hands in celebrating the festival of Haeckel. Hoch! Hoch! Hoch!

Von Zittel.

Another eminent German, just now receiving well-merited honours at the hands of both his and our own countrymen, is Karl Alfred von Zittel, the first palæontologist of the day. In another part of this number (p. 222) we review the great "Handbook of Palæontology," which he has just brought to a conclusion. Here we give a few facts of his personal history, which we hope may prove of interest.

Von Zittel's father was a Protestant minister and head man of the Liberal Party at Bahlingen in Baden. Here Alfred was born on September 25, 1839, and here, amid the volcanic mountains of the Kaiserstuhlgebirge, he passed the first ten years of his life. Then the father was transferred to Heidelberg, where he sent his son to the Lyceum and afterwards to the University. The young student came into very intimate relations with the Professors of Geology and Palæontology, Cesar von Leonhard and H. G. Bronn, and in 1860 took his degree as Doctor of Philosophy. The following year he spent in France and particularly in Paris, where he made the acquaintance of Elie de Beaumont, the Eudes-Deslongchamps, father and son, and many others then or afterwards leaders in the development of geology and the allied sciences. In 1862, Zittel joined as a volunteer the Austrian Geological Survey at Vienna, and during 1863 was employed as an assistant in the royal "Hof-Mineralien-Cabinet." In the latter year he became Professor of Mineralogy and Geology at the Polytechnic in Carlsruhe (Baden), whence, in 1866, he removed to Munich as Professor of Palæontology in the University. In this post he has since remained, adding to it since 1880 the duties of Professor of Geology. Professor von Zittel has travelled much in the interests of science, his most notable expedition being that to the Libyan Desert in 1873-4. In his Professorial capacity, as editor of *Paleontographica*, as editor and part author of the *Handbuch der Palæontologie*, and by his numerous original publications, he has probably done more than any living man to advance his favourite science. He is a member of the Royal Bavarian Academy of Science, Director of the Palæontological Museum at Munich, and Chevalier of the Order of the Crown. He served as Vice-President of the International Congress of Geologists at its Washington meeting, in 1889 he was elected a Foreign Member of the Geological Society of London, and at its Anniversary Meeting this year the same Society awarded him the Wollaston Medal, the highest honour in their power. Lastly, he has been appointed a Privy Councillor of the German Emperor.

In 1863 von Zittel married a daughter of Schirmer, the well-known Düsseldorf painter, then Director of the Academy of Arts at Carlsruhe. An excellent musician, and he is as charming and accomplished in society as he is profound in his own special studies. He speaks our language readily, and has more than once visited England, where he has a friend in everyone that has the honour of his acquaintance.

DARWIN.

MEANWHILE the bidding to "praise famous men" is not being forgotten by Englishmen. The inhabitants of Shrewsbury, in which town Charles Darwin's father practised as a physician and where he himself was born, have, in a numerously-attended public meeting, determined to establish some memorial of the great naturalist. At present nothing definite has been decided, as it was felt that the memorial should not be merely local but national and indeed world-wide. A committee has therefore been appointed to make arrangements for a public meeting of scientific men and others interested in the object, which meeting it is hoped to hold early in March. Anyone who wishes to attend the meeting should communicate with Mr. H. C. Clarke, Town Clerk's Office, Shrewsbury. The suggestions already made are mainly three:—First, to place a bronze statue of Darwin in front of the old school buildings, which are now used for a public library and museum; no more appropriate site could be imagined. Second, to found some scholarship in connection with Shrewsbury School; if the intention be to encourage science, we would suggest that the scholarship should be given to boys on leaving rather than on entering the school. Third, to erect and endow in Shrewsbury a hall for technical and scientific teaching. All schemes are excellent, but the last seems a little ambitious; a combination of the two former seems most likely to meet with general approval. However this may be, we wish all success to the good people of Shrewsbury, believing that such public and visible honour to great workers in science will stir future youth to follow their example.

HARVARD MUSEUM AND SCIENTIFIC CO-OPERATION.

MENTION of "the Pope of Jena," as Haeckel has been bitingly nicknamed by his eminent opponent in "plankton" controversies, Alexander Agassiz, reminds us that we have received the annual report of the latter as Curator of the Museum of Comparative Zoology at Harvard College. Unlike most museum reports, these publications of Professor Agassiz always prove very interesting reading, and this seems to us to arise from the fact that this Museum is not merely a place for the storing of specimens, valuable though its collections are, but is a growing and living institution actively connected with the acquisition of fresh knowledge in all branches of biological and geological research, and with the imparting of that knowledge to eager classes of university students as well as to the larger public. In these respects a museum attached to a university, with properly appointed laboratories and a staff of broad-minded investigators, must always have some advantage over an establishment that is a museum and nothing more. In museums of the latter kind there is an inevitable tendency to ignore the philosophical aspects of the natural history sciences and to exalt the purely

systematic sides of them; and thus the curators of such a museum become finicking specialists, keener to find one spot more on a leopard's coat or one scale less on a butterfly's wing than they are to discover and exemplify fundamental features of organic structure. That this deficiency is due to no causes necessarily attached to museum work is clearly shown by the instructive and beautiful cases placed in the entrance hall of the Natural History Museum at South Kensington, some of which it is now intended to imitate in the Harvard Museum. On the contrary, we believe that the deficiency, where it occurs, is caused by the severance of the museum from the active workers, by the consequent absence of laboratories with proper facilities, and by the financial difficulties in the way of keeping up a complete library of other than merely systematic literature. The only way to overcome these difficulties, which we know to be in force in all parts of the world, is to bring about a more intelligent co-operation of the various government and private establishments with kindred aims, and to resolutely sweep aside the petty jealousies and red-tape restrictions that have no other effect than to hinder true progress.

In this very report before us is a case in point. "It is to be hoped," writes Professor Agassiz, "that some arrangement may yet be made between the representatives of the leading Universities and the Fish Commissioner by which the exceptional facilities for marine research now existing at the Fish Commission Station at Wood's Holl, may be made available for original investigation." The Fish Commission itself cannot spend money on questions with no direct practical bearing on fishery; at the same time it has at Wood's Holl an expensive plant, too extensive for its own needs. If, however, the government bureau and the leading universities could only be induced to co-operate, it would be possible to raise a fund large enough to relieve the Commission of its purely scientific work, and to afford sufficient means for its publication.

Birds' Eggs at the British Museum.

While alluding to the introductory educational series at the Natural History Museum, we should not omit to notice the admirably instructive exhibit of birds' eggs, with which Sir William Flower has recently enriched the central hall. After a description of the structure of an egg, illustrated by a diagrammatic section, the characters of number, form, size, texture and colour, are successively elucidated by specimens and labels. The number of eggs laid in one nest, and sat upon together, though tolerably uniform in each species, varies greatly in different species. Thus, the Manx Shearwater has but one egg, the Swift and Ring-dove two, while clutches of the long-tailed Tit and the red-legged Partridge are exhibited with nine and twelve eggs respectively. In form, eggs may vary from almost spherical, as in

the Scops Owl, to different modifications of elliptical or oval. The latter form, in which one end is smaller and more pointed than the other, though not universal, is the most frequent, and distinguishes the eggs of birds from those of reptiles. If there are many eggs in the nest it is obvious that the conical form makes close packing more easy. Where only two eggs are laid they are seldom conical. Eggs having a pyriform shape, or narrowing very rapidly towards the smaller end are mostly those of wading birds (*Limicolæ*) which lay four in a nest, and are large in proportion to the size of the bird, as exemplified by four Lapwing's eggs. Their pointed ends being turned inwards, they occupy as little space as possible, and are thus more easily covered by the brooding parent. A conical egg placed on the ground or a ledge of rock is less liable to roll away from its place if disturbed, than one of a spherical form. The size of the egg has generally, but by no means constantly, some relation to that of the parent bird. It also depends very much on the degree of development of the young bird at the time of hatching. When the hatched young are immature and helpless the eggs are small relatively to the size of the parent. Such birds usually build carefully-constructed nests. But when the young are well clothed with down and can run and feed themselves, the eggs are large, and laid on the ground or in imperfect nests. The Curlew and Raven are instances of birds of equal size with differently-sized eggs. The Cuckoo, which lays eggs in the nests of birds smaller than itself, has a relatively smaller egg than any other bird. The surface of the shell varies much in texture in the eggs of different birds. Among other examples are the smooth polished egg of the Tinamou, the smooth and glossy egg of the Kingfisher, the dull and chalky eggs of the Ibis and Duck, the eggs of the Ani and Flamingo with a distinct calcareous film, and the rough, pitted egg of the Emeu. The colour of the egg has no relation to that of the parent bird. White is probably the primitive colour of birds' eggs, as it is that of the eggs of all reptiles. The eggs of birds laid in holes, either in the earth or trees, entirely concealed from the light, are mostly white. The larger number of eggs are variously coloured by the deposition of pigment on or near the outer surface of the shell. The colour may be uniform throughout the surface of the shell, or it may be in irregular washes, blotches, more or less circular spots or lines, upon either a white or uniformly coloured ground. The signification of the various modes of colouration is very little understood at present. It often happens that the different species of a natural group of birds present a general similarity in the style of colouration of their eggs, or in other words that nearly-allied birds have similar eggs, a fact exemplified by sets of Warblers' and Buntings' eggs; but the exceptions to this rule are very numerous as shown by eggs of different species of Thrush. In certain cases there is evidently an adaptation of the colour of the eggs to their natural surroundings for the purpose of concealment. Excel-

lent examples of this may be seen in the groups illustrating the nesting habits of British birds in the Bird Gallery. Though the greater number of species of birds lay eggs all of which are of tolerably uniform character, varying only within narrow limits, there are some cases in which the eggs of different individuals of one species present a remarkable diversity, as shown by the eggs of the Guillemot (*Lomvia troile*).

This beautiful exhibit is rather hidden in a dark corner; but we hope that the rapacious schoolboy will ferret it out, and learn that there is something more to be done with eggs than merely to rob the nests of diminishing species. All who see it must acknowledge what beautiful results can be attained in museum work by any curator who spends little money, but much time and brains.

Deficiencies in Museums.

That is one side of the picture; but there is another, not so pleasing. At a recent meeting of the Geological Society of London an eminent palæontologist read a most interesting paper on the wonderful series of bones lately obtained by Mr. Lewis Abbott from a fissure-deposit, apparently of Pleistocene age. He had, however, occasion to lament that the value of his paper was considerably marred by the great difficulty he had met with in obtaining skeletons of many very common species for the purpose of comparison, and by the consequent uncertainty of some of his specific determinations. Some of his hearers were probably astonished to learn how large a number of our common British birds were unrepresented by a single bone in either our great National Collection or in that of the College of Surgeons. Among the species so conspicuous by their absence, the speaker mentioned the Swallow, the Song-thrush, the hairy- and feather-legged Buzzard, not to mention many species of Ducks and Gulls. Other of his hearers may have been filled with sorrow rather than surprise, remembering that this is not the first time such a complaint has been made. The Catalogue of Fossil Birds, officially published by the Trustees of the British Museum itself, remarks on the absence of skeletons of the existing species of *Anas*, and publishes a list of the fossil species which is, for that reason, avowedly imperfect and probably incorrect. Three years ago the author of this Catalogue said, at a meeting of the Zoological Society, whose President is, our readers will remember, the Director of the Natural History Branch of the British Museum: "With regard to the question of extinct species, the unfortunate imperfection of our English collections of recent avian skeletons renders it in some cases impossible to determine definitely the species to which the specimens belong."

It is all very well to attract the public with superb specimens of the taxidermist's art; it is most important that the collections should

be enriched by the acquisition of type-specimens, of rarities and of bird skins from all parts of the world; we do not even grudge the spending of thousands of pounds on illustrated catalogues of these same skins: but surely a Museum that can afford to spend many pounds on a single specimen of a white rhinoceros, might set aside a few shillings for the purchase of skeletons of our common British birds. It is all very well to say that money must rather be spent on rare specimens such as are not to be had every day, that the common things will wait and that people can see them elsewhere if they take the trouble. It should be remembered that for one person who wants to study the rare thing, there are a dozen who want to study the common thing, that these things, common enough now, are rapidly becoming rarities themselves, and that the complaints here quoted are clear evidence of a difficulty actually experienced, not by amateurs, not by private students, not by tyros ignorant of the proper places to go to, but by experienced scientific men themselves in the employ of the State.

It is not for us to enquire who is right or who is wrong; we would merely point out that scientific investigations of the deepest interest, and of importance, even to museums, are constantly hampered by these lamentable deficiencies which might so easily be remedied. We commend the subject to that energetic body the Museums' Association, and especially to its President, Sir William Flower.

THE MODERN MUSEUM.

WE are pleased to learn from its report, that the Association just mentioned is in a very satisfactory state of life and growth. The number of museums officially connected with the Association has risen from 35 to 40, while the number of unofficial associates has risen from 28 to 63. This sudden increase was due partly to the last meeting having been held in London, and is therefore not likely to be permanent. It is more worthy of note that many colonial museums and curators are now to be found on the list. As yet there is only one foreigner, Dr. A. B. Meyer of Dresden; but we see no reason why this Association should not become in time the recognised centre of museum workers all over the world. Local branches and committees would of course be necessary; but if there were a single publication and a supreme council to assist in questions of exchange, the employment of specialists, the distribution of labels and the like, we cannot doubt that great advantage would accrue, not only to museums, but to the arts and sciences illustrated by them.

The report opens with the very interesting address delivered by the President, on Modern Museums. This is chiefly devoted to an examination of the changes rendered necessary in the construction and planning of museums by the altered ideas as to the functions of a museum that have come so much to the front of late years. These functions are two, as expressed by Dr. J. E. Gray at the British Association in 1864,—"first, the diffusion of instruction and rational

amusement among the mass of the people, and, secondly, to afford the scientific student every possible means of examining and studying the specimens of which the museum consists." Sir W. Flower maintains that most local museums should confine themselves to the former function, and that only in national museums can the fulfilment of both functions in fairly equal proportions be expected. In connection with what we have said above on the deficiencies of museums, the following passage is of interest.—"As the actual comparison of specimen with specimen is the basis of zoological and botanical research, and as work done with imperfect materials is necessarily imperfect in itself, it is far the wisest policy to concentrate in a few great central institutions, . . . all the collections which are required for the prosecution of original research," especially collections "containing author's types . . . which must be appealed to through all time to settle vexed questions of nomenclature."

The address concludes with a plan suitable for any museum that proposes to follow up what is here called "the new museum idea." The chief features in this plan are the separation of the reserve collections from those intended for public exhibition, while retaining them in convenient proximity, and the separation of the officers' studies from the galleries in such a manner that they can stay at their work after the museum has been closed to the public. In a footnote, dated November 2, 1893, it is stated that a plan which "closely resembles" this "in essential features" has been found among the papers of the late Sir Richard Owen. It also has the advantage that the recent and extinct forms of each group, though not absolutely incorporated into one series, are brought into nearer relationship to each other than they are at present in the British Museum. We shall never cease to deplore that this plan of Owen's was not adopted, and we learn with interest that it is to be made public in the life of the great Anatomist, already announced by Mr. John Murray.

The House Beautiful.

But perhaps the most interesting paper contained in this report of the Museums' Association is that in which Mr. William White, the curator of the Ruskin Museum at Sheffield, gives an account of Mr. Ruskin's views on the function of museums; and the paper is interesting, not because the ideas in it are new, but because they were, for the most part, put forward by Mr. Ruskin so many as thirty years ago, and yet are a long way in advance of what has since been attempted in the larger number of museums. Indeed, so lofty is the height from which Mr. Ruskin looks at these matters, that we doubt whether even remotest ages will ever see some of his ideas put into practice. So long, for instance, as brains and body require proper nourishment, so long will the students and officials at

a great public museum demand that it shall be furnished with a "cooking apparatus for carnivora."

When Mr. Ruskin requires beauty in a museum we are wholly with him. What can be better than this:—"The first function of a museum is to give example of perfect order and perfect elegance, in the true sense of that test word, to the disorderly and rude populace. Everything in its own place, everything looking its best because it is *there*; nothing crowded, nothing unnecessary, nothing puzzling." Or again, "Above all, let all things for popular use be *beautifully* exhibited." Such a sentence should be borne as phylactery on the apron of every curator. But when Mr. Ruskin restricts beauty to "creatures in their perfectness"; when he denies "anatomical illustrations to the general public"; when he writes such pure Ruskinese as this: "Neither must you ever show bones, or guts, or any other charnel-house stuff. Teach your children to know the lark's note from the nightingale's; the length of their larynxes is their own business, and God's"; then we do think that this honey-tongued prophet of beauty proves himself no true seer. The beauty of an animal or a plant is no more confined to its external form and colouring than are the so-called diagnostic characters which distinguish it as a species apart. A sea-urchin "in its perfectness" is a beautiful object, so is the single richly-ornamented spine of such an animal; but this beauty is entirely the expression of a complicated internal structure, which, when viewed under the microscope, reveals a further beauty that should compel admiration even from Mr. Ruskin. Take him on his own ground. He goes to the British Museum (in 1880) to see a duck's wing, and does not find exactly what he wants. Away, then, with the shells and the monkey skeletons; he must have a gallery full of birds in flight! "What on earth, or in air, is the use to me of seeing their boiled sternums?" Had Mr. Ruskin's flights ever extended beyond his rhetoric, he would probably have found a sternum quite as useful as a wing. Next he will be urging artists to draw ships in full sail with never a spar to desecrate their canvas; the length of their masts is their own business, and the shipwright's.

Apart from this feminine horror of "nasty skeletons," the paper contains much that is valuably suggestive, and it is to be regretted that no discussion took place on it. It is interesting to learn that Mr. Ruskin does not approve of the Sunday opening of museums, that while he would abjure all idea of financial profit, he would charge a small sum for admission in order to keep out "the utterly squalid and ill-bred portion of the people," and that, in his opinion, names of the donors of objects "should cease to encumber either the cases or the scientific guides to them." On points such as these the opinions of professional museum curators would have been worth recording.

In these matters it should be remembered that Mr. Ruskin is no mere visionary schemer. He has given evidence before Parlia-

mentary Commissions on Galleries and Public Institutions, besides his museum at Sheffield he has arranged collections in various parts of the country, and the beautiful book reviewed in another part of this number reminds us how large a share he took in the establishment of the Oxford Museum. This latter was indeed an earnest-hearted attempt to produce a building, which, though devoted to Science, should be a true temple of the Muses, worthy in all respects to be called a House Beautiful. The attempt failed, many will say; failed before a concerted opposition and an unworthy economy. And yet we think that they who have on a summer evening walked in the meadows of the Cherwell, and have seen the pointed outline of the Museum dark against a sunset sky, have then beheld, among all the beautiful sights of Oxford, one that is second to none in either grandeur or beauty.

Winchester College.

One word more on Museums. In this number we are pleased to present our readers with the second article of our promised series on School Museums, in which that of Eton College is described by its present Curator. We hope it will not be long before we deal with the Museums of other of our great schools. But we fear that we shall have to wait long for any account of the Museum of Winchester College. In December last we alluded to the admirable scheme by which it was proposed to commemorate the quingentenary of the School. We regret now to learn that the proposal is not meeting with the warm acceptance that the patriotism of Wykehamists led us to expect. Up to the end of last year only 230 persons had subscribed. It is indeed to their credit that they contributed £3,367 between them, and since then a few more people have promised some £700. This, however, will not go very far, and one cannot help wondering what the many thousand old Wykehamists, who must be in existence, are thinking about. We cannot suppose a want of *esprit de corps* in so united a body; rather we infer a want of sympathy with modern educational needs, similar to that which accounts for the deficiency we have next to notice.

Absence of Experimental Psychology in England.

Some time ago, in reference to a preposterous magazine started by Mr. Stead, sensation-monger-in-chief to the British Philistine, we directed the attention of all interested in problems of mind and consciousness to the scientific organs for the discussion of these problems. In our Reviews for the month is noticed the first number of a worthy addition to these organs,—*The Psychological Review*, edited by J. McKeen Cattell, of Columbia College; and J. Mark Baldwin, of Princeton University, with the co-operation of many well-known

psychologists. We welcome this new magazine heartily, and congratulate its editors on their excellent beginning. But an interesting if somewhat dolorous problem suggests itself here. A large part of modern psychology concerns itself with laboratory work of the kind known as experimental physiological psychology, the application of the exact methods of science to the problems of memory, sensation and so forth. Although this branch of science is comparatively recent, there are well-equipped laboratories for it all over the continent, and the greater colleges and universities of America are no whit beyond. We know of none such in England. It is true that valuable work has been done by Francis Galton, and others, and we may expect more from the new Professor at Owens College. There was a rumour that Professor Burdon Sanderson hoped to establish a new department in connection with the Physiological Laboratory at Oxford, where already a good deal of psychological work has been done under his auspices. But it remains a rumour, and indeed we cannot see how Dr. Sanderson, with a growing medical school and an increasing number of students and graduates engaged on pure physiology, can spare either time or space. England has the men; cannot it find the money? No doubt it is an excellent thing for the race that the distribution of the endowments of Oxford and Cambridge should promote early marriage among those who have distinguished themselves in the classical schools. But there are more excellent and directer methods of dealing with endowments intended to promote learning. One of these, as NATURAL SCIENCE has taken repeated occasion to say, is the assignment of fellowships for branches of learning and research that are of themselves valuable, but open no direct avenues to lucrative employment. So much for Oxford and Cambridge. For other seats of learning devoid of so many pious benefactors in the past, we must hope for practical benefactors in the present.

THEORIES AND FACTS IN BIOLOGY.

LAST month, under the heading "Mathematical Biology," we referred to several interesting studies on variation as it actually occurs. Professor Weldon's insistence on the necessity for accurate information about variation might well be extended to various other chains of facts that form the bases of theories of evolution. Books, papers, and controversies on evolution abound, and in all of them variation, influence of environment, heredity, effects of crossing are the tricks to be made as the cards are dealt and shuffled, shuffled and redealt. The giraffe, fancy pigeons, the tails of lizards, and neuter insects invariably are the court cards, and it would not be difficult to assign equally well-known examples to the plain cards. It is an excellent game, and, as each player holds a full pack and may begin betting when he chooses; the playing is as complicated as the rules are lax. But the giraffe is always the trump card. Lamarck first played it for use-inheritance,

assigning its long neck to the inherited effects of reaching up to high branches; Darwin played it for Natural Selection; Herbert Spencer attempted to take one trick with its neck, another with its legs; Nägeli used it as a trump against selection; Weismann for selection; Professor Henry B. Orr, of Louisiana, U.S.A., in a book noticed among our Reviews, plays it for a system of his own. "The giraffe," he says, "seems to present the most remarkable illustration of the lengthening of the bones as the result of the frequent repetition of shocks. As is well-known, this animal feeds on the foliage of trees. From the earliest youth of the species and the earliest youth of the individual, it must have been stretching upwards for food, and, as is the custom of such quadrupeds, it must have constantly raised itself off its fore feet, and as it dropped must have received a shock that made itself felt from the hoofs through the legs and vertical neck to the head. In the hind legs the shock would not be felt." We are less sorry now that the giraffe is becoming extinct.

But, seriously, this fashion of dealing with the problems of evolution is the most degenerate formalism. No doubt the ingenious schoolman of the middle ages who introduced the burning question of the number of angels who could dance on the point of a needle, introduced it seriously to bring a metaphysical argument to an exact issue. But the example was taken up and argued through centuries till memory of the original question has been lost in laughter at the folly of early logicians. Let us make a concerted effort; let the giraffe be a name not to be named by the votaries of science. Else the laughter of our descendants will be at those word-spinners of the nineteenth century who, having seen no giraffe (save perchance in a menagerie), indulged in copious controversy as to whether or no it distorted its neck and legs by bumping and stretching.

A Whale-Fight in the South Atlantic.

Mr. R. Lydekker, who has recently returned from his journey to Argentina, favours us with the account of an interesting incident of his outward voyage. It is to be hoped that some of our readers, who may have witnessed a similar scene, will be able to throw light on points obscure to our correspondent, who writes as follows:—

"It was on the afternoon of September 9th in last year, about half-past four, that I was standing, in company with a lady fellow-passenger, on the poop of the Royal Mail Company's s.s. "Magdalena," watching the taking of soundings, the vessel being then off the coast of Minas Geraes, Brazil, at no great distance from the islands of Los Abrolhos, in long. 39° W., lat. 18° S. The soundings had just been completed when the attention of my companion and myself was attracted by the appearance of a whale and some other creatures at a distance of apparently something less than a quarter-of-a-mile from the ship. The whale was a 'finner,' of no very great size, and was

seen spouting, and again descending. Immediately after its first descent there appeared above the surface of the sea what seemed to be the tail-fin of some animal unknown. This supposed fin was raised in a vertical position, where it remained vibrating for some seconds and then suddenly disappeared. In colour it was a pure glistening white; while in form it appeared to be laterally compressed, with sharp edges and an acute termination. It gave the impression of belonging to some animal which was engaged in attacking the whale beneath the surface; and I should estimate its height above the water approximately at five or six feet. Soon after the disappearance of this strange white object,—which, both to my companion and myself, seemed most weird-like,—the broad black head of what I presume to have been a killer-whale was seen above the water; and in a few seconds the whale itself again rose to spout.

"The speed that the vessel was going soon left the whole of the group behind; and on going forward I was informed by the commander of the ship (Captain Rigaud), who had been on the bridge during the scene, that one of the animals, which he described as being black, had leapt clean out of the water.

"That these black animals, which appeared to be harassing and attacking the whale, were killers, I have no reasonable doubt; but the question arises as to the nature of the animal to which the strange white tail-like object seen standing above the water could have belonged. My impression at the time was that it must be the upper lobe of the tail of some enormous shark allied to the threshers (*Alopecias*); and this impression has been confirmed by a subsequent examination of the stuffed specimens of that genus in the British Museum. The thresher is, however, a black shark; while, as pointed out by Dr. Günther, the minute size of its teeth seems to discredit the common accounts of its attacking whales. Still, however, I cannot imagine to what animal the aforesaid white tail could have belonged, unless to some gigantic shark allied to the thresher, but of a white colour, and probably armed with much larger teeth. If so, we have evidence of a fish at present unknown to science; and even if I am wrong in this conjecture, the animal to which the object in question belonged would still appear to be unknown, and, in this event, quite unlike any with which we are now acquainted.

"The whole scene, weird and impressive as it was both to my companion and myself, suggested how easily a story of the sea-serpent might have originated therefrom. The black head and body of the presumed killer would have done duty for the head and body of the serpent; while the glistening white object standing perpendicularly above the water would have served for the tail of the same."

ARMOURED WHALES.

THE foregoing narrative shows that we have yet much to learn about even the existing monsters of the deep. Meanwhile, our know-

ledge of the whales of old time is rapidly increasing. Palæontologists have recently been exercised to some extent regarding the affinities of those remarkable gigantic Eocene mammals known as Zeuglodonts, the remains of which have now been discovered in so many parts of the world. Till a short time ago, these animals were pretty generally admitted to be members of the Cetacean order, in which they were regarded as constituting a separate subordinal group —the *Archæoceti*. In a memoir published in the "Studies from the Dundee Museum" for 1890, Professor D'Arcy Thompson took, however, a decided exception to this view, maintaining that the Zeuglodonts had nothing whatever to do with whales, but that their affinities lay rather with the seals. Two years later, Mr. Lydekker, when describing in the *Proc. Zool. Soc.*, some Zeuglodont remains from the Caucasus, again discussed the question, and came to the conclusions that there was no justification for the proposed innovation, and that the Cetacean nature of the group in question was undoubted.

In a recent communication (*Palæontologische Abhandlungen*, ser. 2, vol. i., pt. 5, 1893), Professor Dames has "gone one better" than this, concluding that not only should the Zeuglodonts be classed among the Cetacea, but that there are no grounds for separating them as a distinct suborder from the Odontoceti. He accordingly proposes the following scheme of classification for the latter order :—

1. ARCHÆOCETI ;—teeth few and differentiated. (Zeuglodontidæ.)
2. MESOCETI ;—teeth numerous and differentiated. (Squalodontidæ.)
3. EUODONTOCETI ;—teeth numerous and uniform. { Platanistidæ. / Delphinidæ. / Physeteridæ. }

In the resemblance presented by their skulls to ordinary terrestrial mammals, coupled with the small number of their teeth, the Zeuglodonts are sharply defined from the Squalodonts, and thus form the most primitive of all Cetaceans. The Squalodonts appear, however, on the whole, to occupy an intermediate position between the Zeuglodonts and Delphinoids, and thus serve to connect the three groups of toothed whales.

Not the least noteworthy portion of the Professor's memoir is the one in which he describes certain bony plates found in association with Zeuglodont remains, which are believed to indicate the presence of a dorsal bony dermal armour. That such an armour may have existed in primitive Cetaceans, is rendered the more probable by Dr. Kukenthal's recent discovery of the vestiges of such a structure in the skin of the existing *Phocæna* (*Neomeris*) *phocænoides*.

Possibly the ancient Cetaceans were more exposed to such attacks as the one above described by Mr. Lydekker, and, for this reason, required greater protection. It is well known that the early forms of many groups of animals were provided with some such armour, or evolved some equally adequate means of defence. As

instances, we may mention many of the Edentates of South America, the Carboniferous Camerate Crinoids, the fish of the Old Red Sandstone, the Cephalopods with external shells, and the Operculate Corals of the Silurian. The dermal armour of these ancestral Cetaceans may have been a secondarily-acquired character, from which no particular argument as to their relationships can be drawn.

ÆPYORNIS.

KNOWLEDGE of yet another group of extinct monsters is rapidly progressing. Recent researches in Madagascar, of some of which we gave an account in NATURAL SCIENCE, vol. iii., p. 192, have brought to light many remains of the *Æpyornis*, a bird which some suppose to have suggested the Roc of Sindbad the Sailor. Some of these remains have found their way to the British Museum and have been described by Mr. Charles W. Andrews (*Geol. Mag.*, Jan., 1894). Others have reached Paris and fallen into the hands of Messrs. Milne-Edwards and Grandidier, who, apparently stimulated by the paper of Mr. Andrews, have published an all too brief account in *Comptes Rendus* for January 15. Names are here given to no less than four new species, but, though some measurements are published, we have sought in vain for any adequate diagnosis. Moreover, a new genus, *Müllerornis*, is proposed for three new species of more slender form than those referred to *Æpyornis*, but of this "genus" no further definition is attempted. It also appears that no particular bone is taken as the type-specimen, but that names are applied to collections of limb-bones which may or may not belong to the same species. If this kind of thing continues the confusion of nomenclature in the Æpyornithidæ will soon put into the shade that already obtaining in the Dinornithidæ. Our only remedy is to refuse recognition to all such undescribed "species." There is, however, much of interest in this paper, as it gives, for the first time, a description, though a short one, of the skulls, sternum, and coraco-scapula. The skull is said to be less depressed, longer and narrower than that of *Dinornis*; the temporal fossæ are deep and narrow, while the basi-sphenoid bears strong basi-pterygoid processes as in other Ratite birds. The mandible is straight and strong, with a long compressed symphysis, hollowed like a spoon. The sternum much resembles that of *Apteryx*, being a thin, broad, flat plate, with grooves for the coracoids like those of that bird. The coraco-scapula is much reduced and bears a slight depression for the articulation of a rudimentary humerus. It is to be hoped that we shall not have to wait so long as usual for figures and full descriptions of these important specimens. Meanwhile, it is more clear than ever that, if *Æpyornis* really is the Roc, then it was Sindbad's imagination and not the bird that flew away with him.

I.

The Fossil Plants of Canada as Tests of Climate and Age.[1]

IMPORTANT questions respecting the value of fossil plants as tests of climate and geological age have arisen of late and have been discussed in scientific periodicals and in special works, especially in Seward's "Fossil Plants as Tests of Climate," and Lesquereux's "Final Report on the Plants of the Dakota Group." A consideration of what we have already learned on these subjects from the fossil flora of Canada may therefore prove of service.

In the first instance, it will be necessary to glance, by way of contrast, at the condition of the vegetable kingdom in the Palæozoic period. In this part of the earth's history the problem is complicated by the peculiar character of many of the plants, as well as by the probability that the meteorological conditions were very dissimilar from those now prevailing. We may say in general terms that a flora of tree-ferns, giant lycopods and pines is akin to that of modern oceanic islands in warm climates. This is true; but the Devonian and Carboniferous plants did not grow exclusively on oceanic islands, but on continental areas of considerable magnitude. They flourished also in all latitudes, from the polar region to the equator, and though there are some generic differences in the plants of the period in the Southern Hemisphere, yet these do not seriously affect the general facies. There are characteristic Lepidodendroids, for example, in the Carboniferous of Brazil and South Africa and Australia, and though in the latter region there are certain ferns allied to those of Mesozoic Europe, this is merely a local difference, not materially affecting climate, and corresponding with the fact that the European Mesozoic flora originated in the south. Nor does the doctrine of homotaxis seriously affect the question. Each geological period was sufficiently long to permit plants to migrate to every station they

[1 This article is extracted from the advanced proof of a paper "On the Cretaceous Plants of Vancouver Island," which will appear in the *Transactions of the Royal Society of Canada*, and will end, for the present, the valuable series of papers on the Mesozoic and Cainozoic plants of Canada, with which Sir William Dawson has since 1882 enriched that publication. The present portion, which we have the kind permission of Sir William to reprint, gives the general conclusions based on the whole series.—ED.]

could occupy, and in every case the temporary and local climate must be indicated by the local flora, while the succession in any one place may be relied on as holding good over a very extensive area.

Looking at the Palæozoic plants a little more in detail, we remember that coniferous and taxine trees grow now in very different latitudes and climates. There is, therefore, nothing so very remarkable in their occurrence. The great group of *Cordaites* may have been equally hardy, but it is noteworthy that its geographical distribution is more limited. In Europe, for example, the genus is much more characteristic in France than in Britain, perhaps in connection with the warmer climate to the southward. Ferns and lycopods and mare's-tails are also cosmopolitan; but the larger species now belong to the warmer climates, and nowhere in the present day do they become so woody and so complex in structure as in the older geological periods.

The natural inference would be that in the old coal period the geographical and other conditions must have conspired to give a somewhat uniform and moist climate over a great part of the earth's surface. The geographical arrangements, so far as known, indicate this, and the distribution of animals points in the same direction. In America, for example, the great eastern and western ranges of mountains were yet in embryo, and a large part of the continent was occupied with shallow water or with swampy plains scarcely above the sea-level. The batrachians and insects of the land and the varied forms of animal life in the sea alike point to a climate at least mild and uniform. We must also take into account the probability that there was a larger amount of carbon-dioxide in the atmosphere than at present, which would have greatly impeded radiation from the ground, while the moisture exhaled from the vast swamps and morasses of the period would have produced a similar effect.

It would, however, be a mistake to suppose that there were not local differences of climate. I have in my "Acadian Geology" advocated the theory that the great ridge of conglomerate on the northern border of the coal-field of Pictou, in Nova Scotia, may have been an ice-formed ridge on the margin of the deep morass in which the thirty-six feet seam was deposited. In this case a sea occasionally ice-laden may have approached within a short distance of forests of Sigillariæ and Lepidodendra, and this in the middle of the coal period. On the whole, therefore, we should postulate for the Palæozoic flora not so much a high temperature as uniformity and moisture. This seems also to accord with the prevalent character of the foliage and the structures of the remarkable acrogenous trees of this period.

As to the early Mesozoic flora, the indications are that it was an invader from the Southern Hemisphere, for which the intervening Permian period had prepared the way by destroying the preceding Palæozoic forests. This was probably effected through the agency of

great earth-movements changing the geographical and climatal conditions. But as the Mesozoic ages advanced, the old conditions to some extent returned, and enabled the cycads, pines, and ferns of this age to push their way almost to the Arctic regions. Being, however, derivatives from warmer climates, their vitality and powers of variation were probably not great. They flourished luxuriantly and became considerable coal-producers, and their reign was probably of long duration, extending through the Triassic and Jurassic periods and into the Lower Cretaceous. In the north they met with a new and far more advanced and varied flora, originating there, and destined, in the Middle and Upper Cretaceous, to replace them throughout the whole Northern Hemisphere. This new and most important change was undoubtedly accompanied with climatal amelioration, giving a mean temperature of probably 55° Fahr. to regions within the Arctic Circle; and this, as we shall see, probably depended on geographical arrangements introducing the warm waters of the equatorial current into a vast land-locked basin in the interior of the American Continent, with corresponding though probably not so simple or easily-understood arrangements in the Eastern Continent as well.

Thus, when we ascend from the base of the Cretaceous, we find a remarkable and apparently sudden influx of angiospermous exogens of modern generic types. The aspect of suddenness is given not merely by the rapidity with which from a very few forms the new flora expands in richness and variety, but also by the simultaneous appearance, in the case of many genera, such as *Sassafras*, *Liriodendron*, *Magnolia*, *Quercus*, etc., of as many species in the Middle Cretaceous as the modern world can yet boast, and in some cases of a greater number. On the other hand, it is true that other genera, as *Populus*, *Betula*, etc., appear at first in fewer forms, and are more largely represented in the modern world. This difference is apparently not connected so much with the botanical rank of the several genera as with their degree of adaptation to the more equable climate of the earlier Cretaceous or to the more extreme climates that have succeeded. This climatal change has not only required the removal of some genera to southern habitats and the diminution of their species, but has required that they should be replaced in the north by new species of more hardy types. The southward movement of the whole flora in later Cretaceous and Tertiary times, and the introduction from behind of the modern species, is thus apparently connected with the gradual refrigeration which culminated in the Glacial period.

In Western Canada, in the Rocky Mountains, and in the Queen Charlotte Islands, as well as farther north in Alaska and Greenland, we have a Lower Cretaceous flora characterised by forms approaching those of the Jurassic. One of its characteristic species is a *Dioon*, allied to *D. edule* of Mexico, *D. Columbianus* and *D. borealis*, Dn. Along with this are species of *Zamites* and *Podozamites*, and primitive

species of *Salisburia*, similar to those described by Heer from the Jurassic of Siberia. The lower beds of this (the Kootanie series) are not known to contain any angiosperms, but in beds a little higher (Intermediate and Mill Creek beds) these begin to occur. Newberry has found the same flora farther south in Montana, and it corresponds, in part at least, with the Potomac flora of Fontaine, which occurs over a wide area in the South-Eastern States of the American Union. The geographical distribution of this flora shows an extension of warm climate up to the territory of Alaska. With other geological facts, it also shows that the habitat of the Lower Cretaceous flora was around the margin of a continent not yet elevated into lofty mountain chains, and including to the south a mediterranean sea of warm water; while the conditions in the extreme north must have excluded anything representing the present snow-clad mass of Greenland. This alone is, in my judgment, sufficient to account for the climate of the period, whose warmth extended even to Greenland. I have noticed the nature and correlation of this flora in papers published in the *Transactions of the Royal Society of Canada* (1885, part iv., p. 1, and 1892, part iv., p. 79).

This is succeeded in the north of Canada, at least as far to the south as the latitude of 55°, by the Dunvegan series, holding a warm, temperate flora, containing species of *Magnolia*, *Laurus*, *Ficus*, and *Quercus*, along with such temperate forms as *Fagus* and *Betula*. It also contains Cycads and Sequoias (*Trans. Roy. Soc. Canada*, 1882, part iv., p. 20). It appears to be in the main parallel with the marine Niobrara farther south. This flora is probably continued along the Rocky Mountain region by that of the Mill Creek series, which, however, has more the aspect of that of the Dakota period. (*Op. cit.*, 1885, part iv., p. 11.) It is less rich in cycads and conifers, and has species of *Platanus*, *Macclintockia*, *Cinnamomum*, *Laurus*, *Magnolia*, and *Aralia*. The aggregate of the Dunvegan and Mill Creek series may thus be regarded as Middle Cretaceous or Cenomanian and Senonian, and corresponding in the main to the Atané of Greenland. It belongs to the northern and western sides of the same great Cretaceous mediterranean sea on whose shores the previous Kootanie flora had flourished.

East of the Rocky Mountains this is succeeded by prevalent marine conditions, with the local interposition of the Belly River series, which contains beds of coal, but so far a meagre flora, including *Sequoia Reichenbachii*, *Brasenia antiqua*, *Trapa borealis*, and species of *Acer* and *Populus*.

Passing across the mountains to the Pacific coast, we meet with the abundant and interesting flora of the Cretaceous Coal-measures of Vancouver Island, a truly Upper Cretaceous assemblage. It evinces a still warmer climate than those previously noted, or than the succeeding Laramie; but it is not improbable that already some difference existed in this respect between the Pacific coast and the

interior region of the Continent. It probably coincides with the Patoot flora of Greenland.

Later than this, and in its floral character assimilated rather to the Eocene of other countries, we have the Laramie series proper, indicating a period in which the great interior plateau east of the Rocky Mountains had ceased to be an open sea, and had been reduced to the condition of swamps and lakes, the former holding a rich flora of temperate aspect, even as far north as Alaska and Greenland. The Laramie flora has been recognised locally on the west coast as well, but its greatest areas are in the interior plains, where it undoubtedly overlies the Fox Hill or Danien beds. It is, perhaps, most remarkable for its richness in coniferous trees, *Taxites*, *Sequoia*, *Thuia*, etc., and for the great development of the genus *Platanus*, as well as for its containing some ferns of modern species (*Onoclea sensibilis*, *Davallia tenuifolia*). For details of this flora the reader is referred to *Trans. Roy. Soc. Canada*, 1885, part iv., p. 16; 1886, part iv., p. 19; 1887, part iv., p. 31; 1889, part iv., p. 69.

The Miocene Tertiary is represented on the Canadian plains only by the gravels of the Cypress Hills, holding mammalian bones referred to the White River series; but on the Similkameen River and elsewhere in the interior of British Columbia there are beds holding an interesting insect fauna and a number of fossil plants. Among the latter are several swamp and aquatic species, *Equisetum*, *Azollophyllum*, etc., and conifers of the genera *Pinus*, *Taxodium*, *Glyptostrobus*, and *Salisburia*, along with species of *Myrica*, *Populus*, *Salix*, *Alnites*, *Acerites*, *Carpinus*, *Nelumbium*, etc. The climate evidenced by these plants is still temperate, but probably scarcely, if at all, warmer than that of the coast of British Columbia at present. (*Op. cit.*, 1890, part iv., p. 76.)

It would thus appear that, while we have no evidence of a tropical climate in Northern Canada in the Cretaceous or Cainozoic periods, the successive floras point to equable and warm temperate conditions extending very far northward, and gradually passing in time into those of the colder Miocene and Pliocene. We can also to some extent correlate these climatal conditions with the geographical features of the several periods and with the contemporary animal remains.

I may add that the validity of such deductions does not altogether depend on the accuracy of the reference of particular species to existing genera. In many cases there can be no doubt of this, as in the species of *Liriodendron*, *Sassafras*, *Platanus*, *Sequoia*, and *Salisburia*, and especially in the case of all those forms of which seed or fruit has been procured; but even where the naming may be inaccurate or where the number of species has been unduly multiplied, the deductions as to climate may hold good, though not perhaps to the extent of enabling us to fix a definite thermometrical mean temperature.

As to geological age, the primary requisite is that in some of

the localities of fossil plants their position shall be fixed by stratigraphical evidence. This being done in a few cases, it is not difficult to assign to their approximate position intermediate or allied sub-floras. In Canada, though the collections of fossil plants have not been so large as would be desirable, we are fortunate in having the horizons of the leading floras accurately fixed by the officers of the Geological Survey, and the plants collected carefully referred to the beds to which they belong.

Thus, though the geographical conditions of the Mesozoic and Cainozoic are not of such a character as to enable us to refer sub-floras to their definite geological position throughout the whole Northern Hemisphere in the manner in which this can be done for the plants of the Lower, Middle, and Upper Carboniferous, nevertheless, a satisfactory approximation can be made, and I have no hesitation in affirming that it is possible to define with considerable accuracy the age of any collection of fossil plants from any part of our Cretaceous or Cainozoic districts.

Plants as evidence of geological age have the advantage of wide distribution over the surface of the land, and of long duration in any one place, and slowness of migration when obliged or enabled to spread to new localities. They are also so closely connected with the great movements of subsidence and elevation which mark the lapse of geological time, that they are very certain indices of these, whether they affect plant life directly by elevation and submergence, or indirectly by changing the climatal conditions.

As in the case of animal fossils, we have to allow for differences of station, for possible driftage and intermixture of species belonging to uplands and low levels, and varieties dependent on chances of deposition and preservation. We have also to consider that plants are more permanent and less changeable than the animal inhabitants of the land, so that they may not mark such small portions of time or such minute changes as may be indicated, for example, by mammalian remains.

On the whole there is very good reason to believe that the labours of Palæobotanists have, in the United States and Canada, succeeded in securing for fossil-plants an important place as guides in the determination of geological age. The knowledge we have acquired needs to be collected and arranged in such a manner as to make it more available than it can be when scattered, as at present, through a great number of reports and memoirs.

J. W. DAWSON.

II.

Natural Science in Japan.

II.—Present (*continued from p.* 111).

THE Imperial Museum takes to itself the various functions which with us are distributed between the two sections of the British Museum and the Museum of Science and Art at South Kensington. That is to say, its collections are representative of the Natural History, Antiquities, Art—both ancient and modern, pure and applied,—Resources and technical Industries of the Mikado's Empire. It has, it is true, no immediate connection with the education of the country, since this is amply provided for in other directions and is, for the most part, subordinate to the Imperial University. At the same time, the officers of the Museum have other duties than those of merely conserving and cataloguing the collections committed to their charge. Thus, from the Handbook of the Imperial Museum (*Teikoku Haku-butsu-kwan Yo-ran*) we learn that the officials are instructed to look after the precious objects preserved in temples throughout the country; but perhaps this only refers to those of the state church, which is Shinto, and not to the other purely Buddhist temples. They are also sent out to collect objects, both in Japan and in foreign countries; so that specimens thus obtained are not only cheaper but more authentic than those which pass through the hands of a dealer, while the collector is enabled to obtain that knowledge about the surroundings of a specimen without which the most important collections often lose half their value. It is also considered to be part of a curator's duties to assist students in their investigation of the collections under his care, permitting them to make copies, drawings or photographs of specimens; at the same time he is himself expected to make a scientific study of the specimens and to publish his results. If these instructions, as given in the handbook, are adequately fulfilled, the curators have it in their power to utilise the Museum and their connection with it to far greater advantage than that which can be attained by more tape-trammelled curators nearer home; and we cannot doubt that this will be for the benefit of Science, of the Nation, and of the Museum itself.

The Museum is situated in a prettily arranged garden in Ueno Park. The building, which is two stories high, is of plain semi-

mauresque architecture, with large windows, and appears well adapted for the purposes of exhibition. The offices of the staff are in a separate building at the back. The Natural History collections, with which we are chiefly concerned, are all on the ground floor. It is not of course to be expected that they should contain any specimens of exceptional interest, or be of any great size, since the collections of more scientific importance are at either the University or the Geological Survey office. A walk round the galleries is, however, by no means without interest to the visitor.

The Zoological specimens are arranged systematically and not geographically; still, as the bulk of the collection, at present, comes from Japan, one gets a very good idea of the local fauna. The labels are written in both Japanese and Roman characters, but beyond giving the name and locality they make no attempt to convey information; that is a development which will no doubt come in time. There are, however, a number of old French models of the digestive, respiratory, circulatory and nervous systems in various animals.

As will have been anticipated by those who remember the first part of this account, the arrangement of the Botanical gallery is far superior to that of the Zoological. First are given a series of specimens and models illustrating the different forms assumed by the various organs of a plant: the kinds of roots, kinds of stems, aërial and subterranean, the parts and arrangements of leaves. Then come models for the illustration of the natural classification of plants, and in the next case models to illustrate the Linnean classification. Models of flowers and fruits follow. A selected series of dried plants is exhibited: these are mounted in black frames, hung on screens, and each is accompanied by a coloured plate and an explanation of its position in the system. Thus one is presented with a synopsis of the vegetable kingdom that is both attractive, interesting and readily intelligible. Adjoining this admirable series are additional dried specimens, of local interest, in further illustration thereof. The genera of Japanese ferns are specially represented by a series of dried specimens, with coloured plates and explanations. There are also a collection of the insectivorous plants of Japan and some models of mushrooms. The catalogue of specimens exhibited in this gallery is by Mr. K. Saida, and if he is also responsible for its arrangement, I should like to offer him my congratulations on having interested one so ignorant of botany as I unfortunately am.

The Geological rooms contain nothing of particular interest, except, what seems a useful novelty, a case containing the instruments and reagents employed in mineralogical and petrographical research. The minerals are arranged in three distinct groups, the first illustrating their chemical composition according to the bases, the second according to the acids, and the third the crystalline form. There is a typical collection of rocks from different parts of the world, numbering about 500 examples. The fossils exhibited are mostly

European and largely supplemented by casts, but there are a few Quaternary mammalia of native origin.

Catalogues, printed in English and Japanese, are issued for these three departments, but they are nothing more than lists of names and localities. That to the geological collections is by Mr. M. Nishi, while the zoological catalogue is drawn up by Messrs. Ch. Ishikawa and T. Yuakawa.

The archæological collections of the Museum, though of considerable interest, must not now detain us; nor can one do more than mention the exhibition of native and foreign manufactures, designed to promote the industries of the country, or the various models of native and foreign engineering works. These, as well as the beautiful exhibits of pure and decorative art, are beyond our province. The curators of all departments seem to be doing their work with as much zeal as intelligence; but of course a foreigner is not skilled to judge of the merits of the Japanese labels. It was, by the way, curious that, when I visited the Museum, I could find no official with whom to converse to more than a very limited extent in any European language. In this respect the Museum officials contrasted with those at the University and the Geological Survey. I must not however omit to recognise the courtesy of the Director of the Museum, Mr. Kanaye Kubota, who gave me every information in his power.

We have now considered the chief government establishments connected with natural science in Japan. A few lines only need be devoted to the Learned Societies and minor institutions.

Of Societies the names are legion. As Professor Chamberlain says:—"The Japanese of our day have taken kindly to societies and associations of all sorts. They doubtless feel that their nation has to make up now for the long abstinence from such co-operative activity which was enforced during the Tokugawa *régime*, when it was penal for more than five persons to club together for any purpose." The Geographical Society, or Chigaku Kai, is a private society with about 30 members. The Anthropological Society numbers about 100, and publishes a bulletin which is in Japanese but contains illustrations showing that a vast amount of interesting matter is treated of in its pages. The office of the society is at No. 5, Roku-chome, Hongo, Tokio. The Botanical Society publishes in both Japanese and English. The Zoological, which has about 75 members, publishes in Japanese, but the diagnoses of new species are usually given in some language more intelligible to the world at large. Besides these, there are a Seismological, a Chemical, a Physico-Mathematical, a Geographical, a Philosophical, an Engineering and an Electrical Society, with others more or less connected with science, some of which also publish transactions. The members of these societies are few compared with those of societies with more practical objects. Thus, the Sanitary Society has a membership of over 6,000, the Educational Society over 4,000,

while the Society for the Promotion of Commerce and Industry and the Agricultural Society are equally influential.

In addition to the publications of the scientific societies there is the *To-yo-gak-ge-zasshi*, which literally means the East Ocean Science Art Journal. This was started about 1880, is published at Tokio, and the yearly subscription is one yen, at present about two shillings and sixpence in our money. It is conducted chiefly by University people, and serves to relate the excursions of the students and other details of local interest. It also contains articles by the Professors, and reports of the monthly lectures which they deliver to the general public.

In describing the scientific course at the University, allusion has already been made to the science teaching in the public schools. In the Primary Schools, science is taught by means of object-lessons and talks. In the Middle Schools, which include boys from 14 to 18 years of age, science is taught in all its branches, and such a school is required to have a set of chemical and physical apparatus. Each Middle School has two or three masters who divide between them kindred branches of science. Science is compulsory in these and also in the Higher Middle Schools; but in his second year's attendance at the latter the student confines himself more to his own special subjects. These schools have better laboratories and more science masters, who are thus enabled to devote themselves to more special branches. All science teachers are either graduates of the University or licensed after examination by the Educational Department.

There is of course a large amount of scientific instruction given at the Engineering College in Tokio and the Agricultural Colleges in Tokio and Sapporo, of which the latter was the first founded. These, however, need not detain us now. One may also occasionally come across something of scientific value in the local museums, as at Osaka and Gifu; but their chief intention is to assist commerce and to promote the industries of the country. On the whole, the scientific movement in Japan is concentrated at the capital, and must be studied in connection with those institutions that I have endeavoured to describe in the preceding pages.

III.—FUTURE.

Let not this heading lead anyone to suppose that I am about to assume the prophet's mantle. Zadkiel and the Reverend Samuel Baxter may rest unrivalled. All I intend is to consider the facts already mentioned, as well as certain others that have not yet come within our view, and to suggest from them a few inferences as to the probable development of natural science in Japan, and the relations of that science to the world at large.

There is a tendency to underestimate the solid and original elements of the Japanese character, and to regard the Japanese themselves as a nation of mimics. It is pointed out that the art, the religion, the literature and the government of Japan have, at different times, been transplanted from foreign countries; and there are those who say that these various elements of national life have not greatly improved in the transplantation. At the present day we see the Japanese somewhat too rashly casting aside their ancient traditions and embracing the customs, constitutions and even the clothes of Europe with shamelessly open arms. Science comes with the rest, and we have noted the considerable pitch to which its cultivation is now carried. But, it is asked, will all this endure? When the foreign teachers have been dismissed and when the Japanese endeavour to teach themselves and to advance by their own efforts, will they not sink back into a state of semi-barbarism, from which their present veneer of western civilisation will gradually be worn away? And, what is after all of more importance to Japan, will the nation be able unaided to stand its ground against the plundering hordes of Europe? These sneering doubts come, it must be admitted, with rather a bad grace from a people so indebted to others as we ourselves are. England of the sixteenth century surely owed to Greek philosophy, Roman sagacity, Hebrew religion and Moorish science as much as ever Japan could place to the credit of China and Corea. But, apart from this very obvious analogy, there is no reason why the foregoing questions should be answered unfavourably to Japan. The Japanese are neither parrots nor monkeys. Compare their decorative art with that of China! In all qualities, except perhaps that of technique, it is admittedly superior. As for the Japanese and Chinese theatres, any comparison would be simply absurd; the former is as far above the latter as a "Haymarket" comedy is above a mediæval miracle-play. The fact that there was for two and a half centuries a period of comparative stagnation proves nothing: Europe has had its periods of stagnation too. Now that the incentive has come, there is no reason why we should not behold in Japan a Renaissance with effects as far-reaching as those which were seen in Europe when the re-discovery of the ancient world was followed by the finding of the new.

Such a conclusion will hardly be assented to by another class of objectors. There are people who find in the Japanese nothing but food for mild amusement, and a subject for the cheaper sorts of witticism. As a rule these are the people who see small merit in anything outside England, and it would be waste of time to discuss their opinions. But when we find a writer so in love with his subject as Sir Edwin Arnold uttering sentiments that differ from those of the minor scribblers only in the delicacy with which they are expressed, we feel obliged to give these opinions more careful consideration. Sir Edwin says of the Japanese, "They have the nature rather of birds or butterflies than of

ordinary human beings. . . . They will not and cannot take life *au grand sérieux*." The exaggeration of these statements betrays the practised journalist. Did we not detect here the lurking desire for effect that vitiates professedly ephemeral writing, we should have to suppose that the ascription of a nature so superficial could be based only on superficial observation. Heaven forbid that light-heartedness and abundance of laughter should ever disqualify a people from paying a serious attention to the tasks of life, or make them any the less human beings! But in truth, if the Japanese do not take life so seriously as Sir Edwin Arnold thinks right, they at least take themselves seriously, perhaps a little too seriously, so that we older nations looking on at their solemn performances are sometimes reminded of children that play at being grown up. To compare the Japanese to children is, however, an injustice, and evinces a want of sympathetic insight. They have entered the lists with other nations, and they, if not the others, have the sense to see that the struggle is no child's play. The sincerity of their endeavours was shown only the other day by an instance not wholly foreign to our present purpose. At the Columbian Exhibition almost all the prizes for agricultural improvements were carried off by Canada, largely owing to the admirable system of instruction obtaining in that colony. No sooner did Japan hear of this than she appointed a commission to study on the spot the secret of the Canadian success. The precocity of this child should shame its critics.

No! Grant to the Japanese, by all means, the childlike qualities of sincerity, enthusiasm and imitative power; but recognise that these qualities are at all times admirable, and that in the present instance their value is not impaired by either levity or superficiality. On the contrary, as the description of only one small department of the interests of modern Japan should have shown, the open-eyed observer will note in this people an almost German thoroughness. So far as science is concerned, this may possibly have been, to some extent, derived from their German teachers; but it can hardly be denied that the quality is innate, and there can certainly be no doubt but that, left to themselves, the Japanese better the instruction.

Many, it is probable, will find in the Japanese somewhat too great an appreciation of practical ends, and will remind us gravely that man does not live by bread alone. In the present state of the nation's development the reproach is undoubtedly merited; but what nation that calls itself civilised does not merit it to an equal extent? To those, however, who have the smallest knowledge of Japanese history, to those acquainted (as who is not?) with the artistic skill, the traditional mysteries, the literary enthusiasm and the exquisite taste of old Japan, it will seem absurd to brand these children of the rising sun as devotees of a cold utilitarian creed. The truth is merely the trite one, that if the body be unsatisfied it avails not to satisfy the soul. Japan is struggling for her place

among the nations, for her life itself; that once secured, we have no reason to doubt that she will return to her old allegiance, though perhaps in a modified form. The conditions of modern civilisation do not make for such art as was the soul and the saving of old Japan; but there are other subjects for intellectual activity, and among these one of the noblest and one that may well commend itself more and more to the Japanese in the days that are to come, is the search after knowledge for its own sake.

We may remove from the Japanese the reproach of utilitarianism, but they must retain that of materialism. To a certain extent, however, and certainly so far as it forms a philosophic system, this opposes no serious bar to scientific progress. It is when a man's materialism makes him nothing more than matter-of-fact, when it deprives him of the faculty of imagination, it is then that it impedes his intellectual activity. This is the failing one is said to meet with among the Japanese; and if the accusation be true, those that understand the true value of the imagination in scientific work will see under what disadvantage their students labour. There are many causes for this defect, partly, as we shall see, the language, partly the long period of stagnation already referred to, but chiefly the influence of the Chinese. To know the cause is however, to foresee the cure, and we may well expect that, under the influence of European education, the weakness will gradually disappear.

Another characteristic of the Japanese, upon which everyone is agreed, is their extreme handiness and neatness. How valuable this quality is in scientific work, every scientific worker is well aware.

One should not, perhaps, pass unnoticed here the love of monstrosities to which so much attention was directed in the first part of the present article. This, however, is too obviously a character common to all under-educated persons and nations for us to regard it as in any way a peculiarity of the Japanese. P. T. Barnum did not make his fortune in Japan. Consequently we do not find that the intelligent Japanese zoologists have devoted any abnormal proportion of their time to the study of teratology. In fact the sole instance that comes to mind, if indeed it be an instance, is Watase's paper on the double-tailed gold-fish.

Passing from characteristics such as the preceding, which may be noted by any intelligent traveller, we come to a graver charge, which has been brought against the Japanese by those who have had greater facilities for observation, and longer time for continued study. By many such writers it has been maintained that the Japanese are wanting in philosophic instinct and the kindred intellectual faculties. Kaempfer, for instance, says in his *History of Japan*,—"Now if we proceed to consider the Japanese, with regard to sciences and the embellishments of our mind, Philosophy perhaps will be found wanting. The Japanese indeed are not so far enemies to this Science, as to banish the Country those who cultivate it, but they

think it an amusement proper for monasteries, where the monks leading an idle lazy life, have little else to trouble their heads about. However, this relates chiefly to the speculative part, for as to the moral part, they hold it in great esteem, as being of a higher and divine origin." In our own days, Mr. Walter Dening is said by Professor Chamberlain to write as follows,—"It is well known that one of the most marked characteristics of the Japanese mind is its lack of interest in metaphysical, psychological, and ethical controversy of all kinds. It is seldom you can get them to pay sufficient attention to such questions to admit of their understanding even their main outlines."

Comprehending now some of the tendencies and limitations of the Japanese character, we are better able to see what manner of work their scientific men are best fitted to do. It is clear that their genius leads them in the direction of accurate, detailed investigation; either minute dissections of animal and vegetable structure, careful observation of the habits of living beings, the appreciation of the slight differences so important in the problem of variation, precise chemical analyses and physical measurements, or the construction of elaborate apparatus for determining the slightest changes in surrounding conditions. In the exhaustive and microscopic questionings that the needs of modern science bid us put without cessation to ever-elusive nature, the new Japanese recruits will doubtless prove our most valuable allies.

Turning to the special branches of science with which we have here been dealing, we remember that the Japanese zoologists are privileged to live in a country where the fauna, both of land and sea, is remarkably abundant, while the extraordinary variety of the vegetation will ever render the self-same region a veritable Garden of Eden to the botanist. Both classes of workers may here exercise to the full the nomenclatorial propensities of the old Adam. Many of the native animals and plants have, it is true, been already described by European or American workers; thus Dunker has done the molluscs, Döderlein the sea-urchins, Pryer the butterflies, while besides the botanists previously named we may note Miquel, Maximowicz and Murray, specially instancing the beautiful work "Om Japans Laminariaceer" by Kjellman and Petersen. These and many other active workers have, however, by no means exhausted the treasures of Japan. The Museums already contain large collections of unnamed specimens, now being worked out by native students; while we may expect these collections to be considerably enriched when the northern part of the empire comes to be explored more thoroughly than has hitherto been possible. But it is not merely in systematic biology that we may still expect something new from Japan; this region has already yielded us forms of such far-reaching importance as the king-crab, the giant salamander and the glass-rope sponge, that we may continue to look eastwards for fresh

light to fall on the problems of morphology. As for the geologists, it needs no prophet's tongue to foretell that, for many years to come they will furnish the world with observations of novelty and importance in the branch of their science that deals with volcanoes and earthquakes. Petrology also may be indebted to them; but we hardly dare hope that the greatly altered rocks of Japan will yield the solution of many palæontological enigmas.

There is then a fairly wide field in which the acknowledged powers of the Japanese men of science may well be employed, and their foreign colleagues will await its cultivation with a justifiable hope. One department of science exists, however, in which, if we may place any reliance on the opinions quoted above, the Japanese are not likely to make any conspicuous progress. The world, we may conclude, will never hail a great Japanese philosopher, nor will its line of advance be changed by any new principles emanating from Japan. This very bold conclusion may, however, be rendered invalid by changes similar to those which it has already been suggested will do away with other supposed mental deficiencies of the Japanese. A few such possible changes may now be discussed.

In considering the relations of Japanese science to that of the rest of the world, one of the most patent difficulties, which might almost prevent any relation at all, lies in the language of the country. At the outset there are two obstacles to mutual comprehension: the first is the great difference between the Japanese and European languages in respect of form and construction, the second is the very different mode of writing the two languages. The former obstacle affects the Japanese themselves more than it does the Europeans. There is so much in all European languages that it is almost impossible to express in Japanese; and even when some sort of translation has been effected, the different habits of thought will still render the result largely unintelligible. Thus we may note the absence of all those personal modes of expression and of that constant reference of all surroundings to the speaker as a centre which are of such universal occurrence in our own speaking and writing. Similar to this is the absence of personification of all inanimate and abstract objects. To quote from Professor Chamberlain's fascinating *Handbook of Colloquial Japanese* (p. 272), "Not only does Japanese idiom eschew all such fanciful anthropomorphic expressions as 'the hand of Time' . . . 'Nature's abhorrence of a vacuum,' etc.; but it goes so far as almost to prohibit the use of the name of any inanimate thing as the subject of a transitive verb. For instance, a Japanese will not say 'The rain delayed me,' thus appearing to attribute an action to those inanimate things the drops of rain; but he will turn the phrase intransitively." And again (p. 273), "Thus no language lends itself less to the imaginative and mythopœic faculty than does the Japanese. When, for instance, a European speaks of 'the strife between Religion and Science,' he very likely

spells these names with a capital R and a capital S, and unconsciously slides into regarding them as being, in some sort, actual things, even individualities. . . . Such mythology (for mythology it is, albeit those who have been reared under the exclusive influence of European modes of expression may not recognise it as such) is utterly alien to the matter-of-fact Far-Eastern mind." There are also minor difficulties, such as the apparent want both of a passive voice and of a comparative, all which combine with the others to render the translation of European scientific works into Japanese a matter almost of impossibility. These difficulties are evaded rather than overcome by the necessity the Japanese find themselves under of learning almost all their science through the medium of some foreign language, usually English, and by the growing habit of introducing foreign phrases or at least foreign modes of expression into their own writings.

The second obstacle, that presented by the ideographic writing common to Japan and China, is one that chiefly affects the foreign readers of Japanese, although I am inclined to believe, from conversations with many native friends, that it also places a serious stumbling-block in the way of their own rising generation. It is quite clear that no foreigner, who does not intend to make the Japanese language his life-study, will ever attempt to learn two distinct forms of syllabary and some four thousand ideographs, even for the sake of reading the description of a new species of snail or the account of a novel method of cell-division. Unfortunately one can hardly doubt that the Japanese will not always write their scientific papers in English. Indeed at the present day there is much of value that makes its appearance in the native tongue; and as foreigners come to exert less and less influence in the education of the country the return to the Japanese language is likely to become more general. The prospect is somewhat appalling. Czech is a sufficient hindrance, and Russian daunts most workers: what shall we do when the floodgates of Japanese scientific literature are opened upon us? There is one hope left. The Japanese language does not in itself present insuperable difficulties, and if the Japanese would only consent to write it in the ordinary Roman alphabet, we should hardly have cause for grumbling. This solution of the problem has already presented itself to the Japanese, and in 1885 a society with this object, called the Romaji-Kai, was founded by Professor Toyama and others. Unfortunately the anti-European reaction, which set in in 1889, has made this society somewhat unpopular, and the Japanese students to whom I put the case had plenty of reasons to offer against the proposed change. This is not the place to discuss the question in full; but two facts seem to show that the old methods can hardly survive in the modern struggle for existence. One is that the sender of a telegram is obliged to use either Roman characters or the comparatively simple syllabary known as the Kata-kana. The other is that, even in inland towns such as

Kyoto and Gifu, many of the shopkeepers seem to find it an advantage to write their names up in Roman letters.

A greater hindrance to complete intercommunication of thought than that presented by language may by many be found in the great difference that we have already observed between our own and the Japanese modes of thought. This does not entirely consist in a different attitude of mind or a different temperament, but is to a large extent a result of antecedent conditions. It is hard for us to realise how largely all our Western religion, philosophy and science are the outcome of history, how intimately the present is bound up with the past. But in this past, the common heritage of all European nations, the Japanese have no portion. The allusions, the associations of ideas, the pregnant phrases, the postulated premises: all these inseparable factors of our thought have for the far East no shadow of a meaning. The inevitable to us is the impossible to them.

Of course as the world becomes more of a unit, and as the terms East and West come to have a merely relative significance, these obstacles will gradually disappear; meanwhile it is possible to suggest that they may after all be blessings in disguise. One cannot help seeing that, however much we Westerns gain by our imaginative and mythopœic powers, we are seriously handicapped by this irresistible tendency when we attempt to discuss things as they are. The gross anthropomorphism of all religions that we have at different ages affected finds its parallel in the realms of Science. The Japanese at least are not likely to deify Nature or to make such fetish of a phrase as we have done with "Natural Selection" and "Chemical Affinity." Again, the burden of the past is sometimes as great an incumbrance as ever delayed the progress of the pilgrim Christian. All men know how the introduction of the new scientific methods and the advance of the scientific spirit have perpetually had to struggle with the bonds of ancient belief and to fight to the death with the phantoms of superstition. The bitter feelings thus awakened, and the bigotry thus begotten on both sides, can hardly have advantaged truth or assisted the onward march of the world. Sadly and irresistibly have these events brought home to us the danger of putting new wine into old bottles. Here then is the opportunity of the Japanese, and it is one that they themselves fully recognise. Ignorant of the bonds and unpressed by the burden, they receive from us weapons forged in the fires of controversy and, at last after many a vain experiment, tempered to pierce the dense walls of matter which enshield the secret soul of truth.

F. A. Bather.

III.

Adaptation in Liverworts.

IT is well known among bryologists that the liverworts, unlike their relatives the mosses, are not stereotyped in form, but vary enormously, and in many different directions; they have in consequence been aptly called "one of Nature's experimental grounds." At the outset we have the two great groups of the foliose and thallose —or, according to a more recent and nearly corresponding division, the *acrogynous* and *anacrogynous* forms, with their strikingly different habits of structure and growth, though they are well connected by intermediate forms. Within these divisions, but especially in the acrogynous, there is still an extraordinary variety of form to be seen, and this group will be chiefly dealt with here.

The most important variations are connected with the collection and retention of moisture, as might be expected in plants presenting a small surface, and developing unicellular root-hairs only, which cannot penetrate the substratum to any considerable depth. Results of investigation in this department have been recently published, which show a remarkable power of complex adaptation in these lowly plants (1, 2).

The typical form of the acrogynous Jungermannieæ is a thin, usually more or less prostrate, stem, bearing three rows of leaves, two lateral and one ventral. Those of the ventral row (amphigastria) are usually very much smaller than the others, and are often absent altogether; in the latter case the ventral segment of the three-sided apical cell forms stem tissue only, while the lateral segments produce each a row of leaves. The leaves are commonly bidentate or bilobed, and in the simpler forms, as in the common *Lophocolea bidentata*, the lobes lie in the same plane, so that there is no provision for retaining moisture other than the capillary action among the leaves and stem. Such forms commonly possess well-developed root hairs, sometimes in enormous numbers; while in a few species, *e.g.*, *Lepidozia reptans*, there are whip-like branches bearing only rudimentary leaves, but densely clothed with root hairs, which are apparently modified for this purpose.

Coming now to those forms which possess some kind of water-collecting apparatus, we find, as Goebel has shown, four chief classes,

each with its own type of structure, whereby the same end is attained.

It must, however, be remembered that in the Muscineæ water is absorbed by the leaves, and in those which have a soft stem by the whole surface of the plant.

(1.) First, there are leaves which are simple in shape, but are cut up, and form a more or less spongiose mass. In *Ptilidium ciliare* and others the main part of the leaf is a cellular plate, but the border is divided into a large number of hair-like cell rows. In species of *Trichocolea*, however, there is scarcely any cellular plate at all, the leaf being cut down to its base, and resembling a densely-branched twig (Fig. 1). The effect of this is very well seen when the British species (*T. tomentella*) is gathered in damp weather, as it can then be wrung like a sponge.

The following types depend upon the alteration of the form of the leaf.

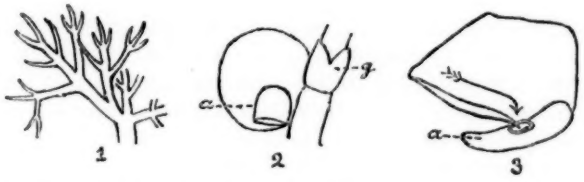


Fig 1. Part of leaf of *Trichocolea tomentella*.
Fig. 2. *Frullania dilatata*; *a*. auricle or water sac—*g*. amphigastrium.
Fig. 3. Leaf of *Physiotium giganteum*; *a*. auricle.

(2.) In species of *Lejeunia*, *Radula*, etc., the lower lobe of the bilobed leaf does not lie in the plane of the upper lobe, but is turned forward, so that the lobes are apposed. The advantage here lies in the increased capillary surface, while in some species a simple sac is produced by the depression of the base of the leaf.

(3.) In the British species of *Frullania* a considerable advance upon the foregoing is found in the bending and hollowing out of the lower lobe, which forms a cup-shaped sac, with a wide mouth opening posteriorly (Fig. 2). In a foreign species (*F. cornigera*) there are two sacs to each leaf, and the mouth is narrower than the basal part. It is interesting here to note that such sacs are not confined to the foliose forms, since in *Metgeria saccata*, one of the thallose Jungermannieæ, projections are developed at the edge of the thallus, which bend round and form sacs comparable with those of *Frullania*.

(4.) The last type presents a highly-organised water-sac, or auricle, with its mouth towards the middle or base, and protected by a valve. This sac, which is comparable in structure and development with the bladders of *Utricularia*, is found in species of *Colura* and *Physiotium*. In *Physiotium giganteum* (Fig. 3), a plant inhabiting the dry mountain regions of India and Ceylon, the sac is subulate, and has a

circular mouth, bounded by a strong rim or collar, opening on the side next to the stem. Direct entrance is impossible, as the mouth is closed within by the depressed tissue of the circular area of the mouth, and entrance can only be effected by a passage downwards between the two flaps of the valve. One of these flaps is rigid, and exactly like the rest of the foliage in texture, but the other consists of thin-walled, empty, and dead cells; the latter forms the "clapper," and by its easy movement the opening and closing of the valve is effected. The shoots bend outward from the tree to which they are attached and grow vertically upward. The provision for the conduction of water into the auricle is remarkably perfect. "The upper lobe is well adapted, both by its shell-like form and its position on the upright stem, for catching and holding water, which, owing to its oblique position, will naturally flow toward the auricle. It is prevented from running off by the lower edge being strongly incurved, thus forming a channel in which the water may collect, and leading to the mouth of the auricle. The curved edge of the lobe is continued by a projection into the mouth of the auricle, the upper edge of which is raised to prevent the water escaping at the junction of the two members, while a depression below forms a channel which ensures the entrance of the water into the auricle" (2). How effective a water collector this plant is may be readily seen in the epiphytism it engenders, a variety of small plants and animals being commonly found in the sac, while a species of *Frullania* was in some cases so closely applied to the shoots as to be invisible except on close examination.

There is yet another means whereby water is collected and held, viz., the perianth or colesula. This is a more or less cylindrical sac, which develops around the archegonia, and after fertilisation elongates considerably, and encloses the developing sporogonium. As it stands vertically, and is in most cases much larger than is necessary to cover the young sporogonium, it will doubtless catch more or less water, which in those having a contracted mouth will be held with great tenacity. But in a number of species the colesulæ are mostly, and sometimes entirely, barren, the archegonia being in some cases entirely suppressed. These barren colesulæ are occasionally produced in immense numbers, as in *Physiotium acinosum*, where they form the main mass of the plant, the stem and leaves being small and comparatively insignificant; and that they function as water sacs is evident from the fact that water can be wrung from the fresh plant after weeks of rainless weather in a dry locality. There is, however, a disadvantage in this habit, as seeds are enabled to germinate in the vicinity of the liverwort, and the seedlings send their roots into the colesulæ and rob the plant. But the advantage to the "epiphyte" is very great, as the plantlets, which otherwise might not have germinated at all, have now become independent.

Another interesting point which has been recently brought to light is concerned in the moistening of the apex. The mucilaginous papillæ

in the thallose forms, developed immediately behind the apical cell, are well known. It is now known that similar papillæ are commonly formed at the apex of the very young leaf in the foliose forms, and hang over the apical cell. This uses up the apex of the leaf, and the main part of this organ is subsequently formed by intercalary growth. The papillæ usually occur singly or in a pair on each leaf; but in *Physiotium giganteum* there are three to each upper lobe, which hang over the stem apex, so that the leaf in this state presents an appearance irresistibly recalling the jester's cap and bells.

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JESSE REEVES.

IV.

Thermo-metamorphism in the South-Eastern Highlands of Scotland.

IN the north-east of Forfarshire, there is a tract of moorland, much covered with peat and heather, that forms part of the singularly flat table-land of the south-eastern Highlands. It is drained by the North and South Esk, and in the craggy sides of their valleys may be seen exposures of the gneisses and schists of which the area is chiefly composed. Glen Clova, to the south-west, is especially well-known for its picturesque scenery. A detailed study of this area shows that there are several masses of intrusive rock, gneiss, and granite, which are probably connected underground, and that the highly crystalline character of the surrounding schists is the result, mainly, of thermo-metamorphism, or of alteration by heat rather than by pressure and mechanical movements. This conclusion is of some interest, as the special features may, after all, have no necessary connection with great antiquity, but be due to the depth in the earth's crust at which the metamorphism took place. It serves also to strengthen Dr. Barrois' views that regional metamorphism and contact metamorphism are much the same thing, differing not in *kind*, but in *degree*.[1]

The ordinary condition of the intrusive rock is that of a slightly foliated granite, with two micas: muscovite or white mica, and biotite or brown mica. Hence the rock may be termed a Muscovite-biotite Gneiss. Intruded among the schists are a number of pegmatites, or veins of coarse granite, the origin of which was uncertain; but they have now been traced to the parent mass of granite rock—the muscovite-biotite gneiss.

In considering the effect of the forcing of a granite magma, under enormous pressure, into the surrounding rocks, we have practically to deal with a process akin to that by which silver is extracted from lead. Just as the silver crystals are strained off from the lead at a certain temperature, so certain crystals are strained off from the granite-magma during the process of forcing it through every crack

[1] General results of paper "On an Intrusion of Muscovite-biotite Gneiss in the South-east Highlands of Scotland, and its accompanying Metamorphism." *Quart. Journ. Geol. Soc.*, vol. xlix., pp. 330-358, pls. xv., xvi., 1893.

and plane of weakness in the surrounding rocks. This results in leaving behind large masses of rock composed of what are known as the "earlier crystals of consolidation," while the residual liquid is forced upwards and outwards, finally consolidating as extremely coarsely crystalline veins and masses known as pegmatites, or "giant granite." A peculiarity of the present instance is the enormous distance to which these veins extend from the parent mass. Perhaps no case has before been clearly established in which pegmatites extend so far as a mile from the surface outcrop of the parent mass of any granite of post-Cambrian age; but in the area under consideration these veins extend as far as 40 miles from any exposure of the muscovite-biotite gneiss.

These pegmatites throw great light on the sequence of the rocks in this intensely-folded area. Obviously, if by a great normal fault, rocks which are penetrated by igneous veins are brought against rocks which these veins have failed to reach, the permeated rocks must be the lower of the two, and we are thus able to show that one group of rocks is higher or lower than another. A starting-point of this nature is invaluable in an area where it is difficult to say if any dip is true or reversed. It may be here noted that the characteristic feature of the pegmatites is the presence of large crystals of muscovite. The original magma consolidates normally as a true granite containing white and brown mica, but the pegmatites never contain large crystals of brown mica. This leads to the natural inference that the pegmatites bearing brown mica, such as may be seen at Cape Wrath, are the upward prolongations of a granitite magma, or one which contained brown mica only and not white mica, and which has been injected under precisely similar conditions to those of the south-eastern Highlands.

Most interesting is the development, over a vast area, of certain minerals, such as sillimanite, cyanite, and staurolite, which have already been described by many authors as the result of the intrusion of large igneous masses into sediments. The development of these minerals is found to be dependent on nearness to or distance from the main intrusion, and it may be further added that the crystalline condition of the entire region may be said to "rise or fall" away from the main intrusion, just as the pegmatites do or do not reach the surface. From these facts it may be inferred that the upward permeation of igneous (often gneissose) material must have taken place over a large part of the southern Highlands. In the ordinary post-Cambrian granites, the development of certain minerals occurs practically within cylindrical rings, one outside another, surrounding the inner cylinder of granite. Here, however, we have a new phenomenon to deal with. The thermo-metamorphism is dependent, not so much or so entirely on the distance away from the parent edge of the igneous mass, but rather upon the fact of the rocks being at a greater or less height above what we may

conveniently term the "upper saturation limit" of igneous material. There is no reason to believe that a similar saturation is not going on now under volcanic areas. Nevertheless, the vast depth required for the rocks to have a sufficiently high temperature for the extremely slow cooling of the giant granites, points to an equally vast time to allow for denudation to expose them at the surface. This at once suggests the great antiquity of areas in which the phenomena referred to are seen. It is, however, well within possibility that, in special areas where denudation has acted powerfully for a long period, this phase of intrusion may be exposed, though it took place in post-Cambrian times; but the proofs of it should be placed beyond reasonable doubt.

George Barrow.

V.

The Museums of Public Schools.[1]

II.—ETON COLLEGE.

THE present Eton College Museum, which forms part of the block of buildings known as the Queen's Schools, was completed only a few years ago. Before that day there existed, on the present site of the Queen's Schools, a large round building (the Rotunda) and a number of small class-rooms known as the Old Mathematical Schools. After the completion of additional class-rooms for the mathematical work of the school, the Rotunda was used for various purposes until the year 1875, when it was, at the expense of several of the Science Masters, fitted up as a Museum.

At this period a set of British birds, stuffed in separate cases, together with a series of British butterflies, formed the nucleus of the zoological collection, while a large number of mineral specimens and fossils, got together by gift and purchase, formed the nucleus of the geological collection.

About the year 1888 the Rotunda and the Old Mathematical Schools were pulled down, and the present Queen's Schools were erected on the site. The Queen's Schools consist of a block of buildings on three sides of a quadrangle, the centre of which is occupied by a grass plot. The whole of the northern side is occupied by the new Lower Chapel, built by the subscriptions of old Etonians. On the south side is a large lecture-room and a physical laboratory, a large drawing-school, and several class-rooms. The western side of the block is not built upon, and the eastern is almost entirely occupied by the Museum, with a line of class-rooms on the ground floor beneath.

The eastern and southern sides of the quadrangle, with the exception of the Physical Laboratory and Lecture Room, the funds for which were provided by the Head Master, Dr. Edmund Warre, were built by the College out of their endowment.

The architect of the whole block of buildings was Sir Arthur Blomfield.

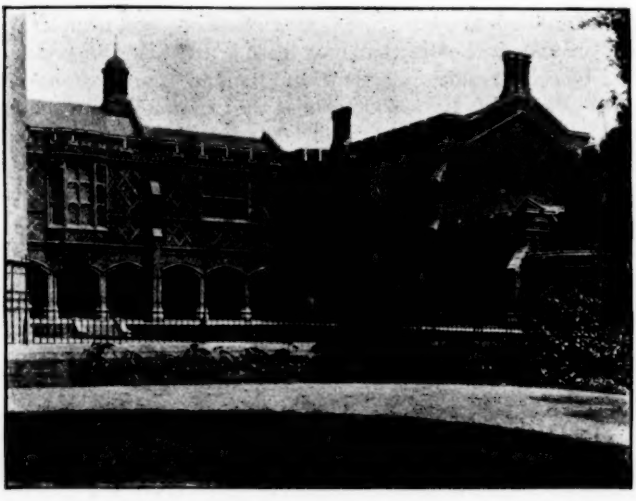
The Museum consists of a large room (87 ft. by 30 ft.) and a small

[1] The first of this series, on Charterhouse, appeared in this Journal for July, 1893.

adjunct. The principal room is very well lighted by a double row of upright skylights, which extend along the whole length, and by seven large windows.

The window at the northern end of the room is filled with stained glass, and was formerly in the old School Library, where it was put up by old Etonians during the head-mastership of Dr. Hawtrey. It is an heraldic window, containing the arms of Eton and of various personages and institutions connected with the school.

The northern end of the Museum, which is separated to a certain extent from the rest of the room by arches and pillars, forms a library, in which there is an excellent collection of books on Natural History; it is further furnished with tables and chairs for the purposes of reading and study.



THE ETON COLLEGE MUSEUM.

The books comprise text-books, books on the British fauna, natural history, travels, etc., etc., and include a complete collection of the Palæontographical Society's works, and of the scientific reports of the voyage of the "Challenger."

In the three years during which the Museum has been opened its contents have increased rapidly; but before giving an account of what the collections now consist of, it will be perhaps useful to give a sketch of what a museum of this sort should contain; in fact, of an ideal School Museum.

There are two very distinct and separate classes of boys to whom a School Museum will appeal: these may be called the Professional and the Amateur. Of these, the former, though considerably the

smaller in numbers, will make much more use of the museum, while the Amateur class is much more numerous, especially in a Classical School like Eton.

The Professional class of boys are those who are taking up, as part of their school-work, some scientific subject, such as Biology or Geology. For the Biologists, a good typical series of well-named and well-labelled specimens, illustrating the structure and principal forms of the animal and vegetable kingdoms, is required. For the instruction of the Geologists, a good typical series of rocks, minerals, and fossils, arranged in stratigraphical order, is necessary. All the specimens can, of course, be removed when required to illustrate lectures on either subject.

For the Amateurs, by which name I designate those boys whose

INTERIOR OF THE ETON COLLEGE MUSEUM, LOOKING NORTH.

interest in Natural History has been aroused by making such collections as those of butterflies and birds' eggs, a different series of collections is required. For this class, what is mainly wanted is a set of specimens of the British fauna as complete as possible. Mammals, birds and their eggs, and insects are, of course, the groups in which the greatest amount of interest is shown, and it is especially to those groups that attention should be directed. Moreover, as many of the Eton boys come from very different parts of the British kingdom, it seems unwise to limit the faunal collections to the productions of the neighbourhood of Eton.

The local School Museum should, therefore, in my opinion, contain :—

1. Faunal collections limited to the British isles.
2. Small, well-chosen, typical collections to illustrate the forms of animal- and plant-life, together with typical collections of minerals and of fossils, stratigraphically arranged.

A brief account of the present contents of the Eton College Museum may now be given, to show how far it comes up to the ideal, and in what ways it is still deficient.

The north end of the Museum is occupied by three large mahogany table cases, containing a small but useful collection of Invertebrates. The dried specimens are arranged in the table-cases, the bottles containing preparations of the softer-bodied animals are placed on shelves between the two glass lids of the cases. Most of the contents of this collection have been purchased from time to time from the Naples or the Plymouth Zoological Stations.

The collection destined to illustrate the Vertebrate series is much less advanced; as yet it consists only of a few skeletons and preparations placed in a wall case.

With regard to the Faunal collections, the Mammals are not as yet very far advanced, but the Museum possesses a very good collection of stuffed birds, each species being mounted in a separate glass-fronted case. This collection is interesting historically, having been formed by Dr. Thackeray, the late Provost of King's College, Cambridge, who was a friend and correspondent of Yarrell. It is said to have been used by Yarrell while writing his celebrated "History of the British Birds"; indeed many of the well-known figures in that work seem to have been drawn from the birds now in the Museum.[2]

Provost Thackeray left his collection to the School, and it formed for a long time the nucleus of the Museum in the Rotunda above mentioned. Although it was made so many years ago, the specimens still remain in a very fair state of preservation, except for the fading of some of them. It is arranged along the walls on both sides of the room.

It has been lately proposed to add to the mounted series a collection of British birds "in skin," which will be much more useful for close examination and handling, and a beginning has already been made in this undertaking.

The collection of birds' eggs is arranged in glass-topped boxes and placed in drawers of a special cabinet presented by Mr. A. C. Benson, one of the Masters; the collection has increased a good deal during the last two years, but is still by no means perfect.

A very good series of British butterflies and moths, arranged in six cabinets, was presented many years ago to the school in memory

[2] *See*, for example, the Alpine Accentor, shot in the garden of King's College, Cambridge, on November, 1822, Yarrell's "History of British Birds," ed. 4, vol i., p. 296.

of Arthur Vernon Jones, an Eton boy, who himself collected the greater part of it.

The Geological collections are arranged in three long table-cases, extending two-thirds of the total length of the Museum. One of these is occupied by fossils arranged stratigraphically, another by a collection of rocks and minerals, and the third by a set of cases illustrating economic processes, such as the ores, varieties and uses of coal, sulphur, iron, tin, lead, and soda.

The collections in these cases have been received from various sources; a considerable number were given by Eton Masters—the late Mr. P. H. Carpenter, Mr. Hale, and the late Mr. Drew and others. A large number of the specimens, especially of the fossils, were purchased from Mr. J. R. Gregory, who also named and arranged most of those already in the Museum.

The Museum now possesses a very excellent collection of minerals, derived from three sources. (1) A collection in a cabinet presented by the Rev. S. A. Donaldson, an Eton Master; (2) a collection made by the late John Murray, of Albemarle Street, and recently presented in memory of him by his son, the present Mr. John Murray, also contained in a cabinet; and (3) a collection specially formed for the Eton Museum at the Natural History Museum at South Kensington.

There is one set of objects in the Museum which has a very close relationship to Eton, and in fact forms almost the only part of the Museum which has a distinctly local interest. This is a series of prehistoric implements of neolithic age, which has been obtained by Mr. Edward Hale from the men who dredge for gravel in the Thames. Besides many examples of the ordinary type of adze, the collection contains flint-chippings, arrow heads, bone-needles, and all the other characteristic remains of the neolithic people, including a remarkable dolichocephalic skull dredged up in the same way.

There is also a small collection of anthropological implements, of which the larger objects such as clubs, weapons, etc., etc., have been mounted on a large wooden shield. This collection was made by the late Sir John and Lady Franklin, and presented to the Museum by Mr. G. B. Austin Lefroy.

A great speciality has been made of photographs in the Eton Museum; a large collection of Gambier Bolton's well-known studies of animals, mounted and framed, with short descriptions and small maps of the geographical distribution, form a prominent object on the south wall of the Museum. We have also got three of Mr. Saville Kent's photographs of the Great Barrier Reef which were specially enlarged for museum purposes, and finally a considerable number of photographs of geological phenomena have been accumulated, all of which are mounted and framed, with descriptions appended and hung on the walls.

The Museum is open every day, except Saturday, between the

hours of 12 and 2, and on whole-school days (*i.e.*, Monday, Tuesday, Wednesday, and Friday) between 4 and 5. Lately the experiment of opening on Sunday afternoons has been tried, and has succeeded admirably. A very large number of boys avail themselves of this opportunity every Sunday, but it must be confessed that the week-day attendance is rather meagre. Whether this can ever be remedied is a difficult question, the present Eton boy having very little leisure during the day. Besides the regular school hours, which, it must be confessed, are not too long, a large amount of time is taken up by the average boy in learning his lessons and also "extras" (*i.e.*, private tuition in extra subjects). When to this is added the time necessarily spent in games, there is very little leisure time left to the ordinary Eton boy for improving his mind, even if he wishes to do so.

The conception and carrying out of the Eton Museum has been almost entirely due to Dr. Warre, the present Head Master, who has always shown a most keen appreciation of the advantages and uses of a School Museum. In these ideas he has been ably seconded by the scientific members of the staff of masters: Mr. Hale and the late Messrs. P. H. Carpenter and J. Drew, who have all largely contributed out of their private means to the support of the Museum. The greater amount of the actual work of planning and setting in order the Museum as it now is, was, however, undertaken by Mr. A. Vaughan Jennings, who, after a year's hard work, had to resign the post of curator on account of ill-health.

W. L. SCLATER.

VI

Instinct and Intelligence in Chicks and Ducklings.

IN my "Animal Life and Intelligence" I quoted some of Spalding's statements as to the intelligence of young birds. I then received a letter from my friend, Mr. T. Mann Jones, informing me of observations of his own which did not accord with those which I quoted, and expressing some scepticism as to the existence of what he termed "the philosopher's chick." I therefore determined to observe for myself, and the following paper contains some account of my observations, which should be compared with those of Douglas Spalding in *Macmillan's Magazine* for February, 1893, and those of Professor Eimer in his "Organic Evolution" (English Translation, p. 245). I desire to express my acknowledgments to Mr. Mann Jones for his suggestions and criticisms.

The eggs were incubated under the hen until about the third day before hatching, when they were transferred to an incubator. After hatching the young birds were left in the drawer of the incubator for from twelve to twenty hours. They were then kept under observation in a small pen surrounded with wire netting in my study. There was thus no influence of adult birds. I was their only foster-mother. I shall describe the observations under the head of the day of chick or duck life—first day, second day, and so on—dating from their removal from the incubator drawer.

FIRST DAY.—*Chicks.*—On opening the drawer of the incubator the newly-hatched birds are often seen to huddle together and to try and burrow under each other. Experiments on the co-ordination for pecking show that any small conspicuous object is struck at. The aim was seldom quite correct, the tendency being apparently to strike somewhat short. Moving the object a little with a long steel pin caused it more readily to catch their eye. It was generally seized at the third or fourth stroke, but a little awkwardly, and was not always successfully swallowed. Flies, from which a portion of their wings had been removed, were followed as they ran, and were seized at from about the seventh to the twelfth stroke. The chicks pecked persistently at their own and each other's toes and at the bright bead-like eyes of their yellow neighbours, also at excrement, shaking their heads and wiping their bills.

Ducklings.—The pecking co-ordination was imperfect. When a piece of white of egg was seized it was mumbled rapidly and shaken out of the bill unswallowed. Towards the close of the day they began to swallow what they seized, but the pecking co-ordination was not quite perfect. They were at first very unsteady on their legs (more so than the chicks) and tilted over backwards on to their tails. One scratched its head, but toppled over, the double co-ordination of standing on one leg and scratching its head was more than it could manage. They walked several times through the water placed in a shallow tin, but took no notice of it. I dipped the beak of one of them in the water; it then drank repeatedly, shovelling up the water with characteristic action. Presently the others imitated the action and drank freely. I dropped, at different times, two ducks into a tepid bath. They kicked vigorously and excitedly, dropping their excrement, but in a minute swam about with easy motion, pecking at marks on the sides of the bath.

SECOND DAY.—*Chicks.*—Several ran repeatedly through the water in a shallow tin, but took no notice of it. Then, after about an hour, one of them standing in the water pecked at its toes. It lifted its head and drank freely with characteristic action. Another subsequently pecked at a bubble near the brim and then drank. The stimulus of water in the bill at once led to the characteristic responsive action. Others came up and pecked at the troubled water; they too then drank. Later on one was running and toddled into the tin; it stopped at once and drank. Wet feet seemed to suggest drinking by association. I placed two winged flies before them. One chick seized a fly at the first stroke. Another followed the second fly and made three pecks at it, but the other chick rushed in and caught it at the first stroke. A large winged fly thrown among other chicks was approached by one bird which gave the danger note (a very characteristic sound). Subsequently the same chick followed it and caught it after several bad shots. They pecked about equally at four kinds of grain, millet, canary, groats, and pari; but swallowed more of the millet. They also pecked at and swallowed sand grains. I took one of the chicks and put it down near a young cat. The bird showed no signs of fear.

Ducklings.—Both ducks made at once for water in shallow tin, drank and squatted down in it. They ate keenly of white of egg, swallowing large morsels, the pecking co-ordination being nearly accurate. Both scratched their heads occasionally and toppled over. They preened the down, especially of the breast, in characteristic fashion; they also applied the bill to the base of the tail and rubbed the sides of their heads along the back in quite approved duck fashion. They stood up stretching out their necks and flapping their wings, sitting down on their tails from imperfect co-ordination. They showed much less accuracy of aim than the chicks in catching running flies. The abortive attempts were numerous.

They ate their own and chicks' excrement freely and showed little sign of disgust. (In South Africa young ostriches are often supplied with the droppings of the old birds, for medicinal purposes. So I was informed).

THIRD DAY.—*Chicks.*—The chicks pecked excitedly at flies placed in an inverted tumbler, but failed to catch them on the wing when the insects were allowed to escape. They still peck at any small objects, especially bright ones, but show more discrimination in swallowing. They run to one's hand when one pecks on the ground with one's finger or a pencil, simulating the action of a hen. One can thus induce them to seize objects which they would otherwise leave untouched. They will always run to nestle in one's hands, poking their heads out between one's fingers prettily. To some chicks (Group A) I threw cinnabar caterpillars. They were seized but at once dropped, with some wiping of the bill. The caterpillars were uninjured, and were seldom touched again. They were removed and thrown in again towards the close of the day. Some chicks tried them once, but they were soon left. I could induce birds to pick them up by "pecking" with a pencil, but they were at once dropped.

Ducklings.—There was nothing special to note.

FOURTH DAY.—*Chicks.*—I threw to the chicks of group A some looper caterpillars and some green caterpillars from gooseberry bushes. They were approached with some suspicion. Presently one chick seized one and ran off, giving rise to a stern chase. Another stole it from the first and ate it. In a few minutes all the caterpillars were cleared off. Later in the day I gave them more of these edible caterpillars, which were eaten freely. Then some cinnabars. One chick ran, but checked itself, and without touching the cinnabar wiped its bill (association). Another seized one and dropped it at once. A third subsequently approached a cinnabar as it walked along, gave the danger note and ran off. Then I threw in more edible caterpillars, which again were eaten freely. The chicks thus discriminate by sight between the nice and the nasty caterpillars. To a second group (B) I threw cinnabars and small worms. Both were seized at first with equal appetence, but discrimination was soon established. The chicks began to scratch the ground (perhaps also the day before, but not markedly). Several of them pecked at the burning end of a cigarette two or three times, but some were stopped by a whiff of the smoke, and then shook their heads and wiped their bills. Subsequently, when the cigarette was out and cold, they came and looked at it; and one, after eyeing it, wiped its bill on the ground. A large *Carabus* beetle, sprawling on its back, was an object of fear; one chick at last pecked at it, uttering the danger note, and threw it on one side. After this none went near it.

Ducklings.—Experiments with cinnabar caterpillars, loopers, and worms gave similar results to those obtained with the chicks.

FIFTH DAY.—*Chicks.*—One of the birds, bolder than the rest, would eat large flies with relish. I threw in a bee. Most of the chicks were afraid, as they were of large flies. The bolder chick, however, snapped it up and ran off with it. Then he dropped it and shook his head, wiping his bill. Probably he tasted the poison and was not stung; in any case, he was quite lively and unconcerned in a few minutes; but he did not touch the bee again. The chicks preened their down early on this day. If they had done so before, I failed to note the fact. Later in the day I put beneath a tumbler a large fly and a small humble bee with a sting. Two of the chicks ran round the tumbler pecking at the insects. I let the bee escape. The bolder chick seized it, dashed it against the ground, and swallowed it without a wink. With another group of chicks I first gave bees, which were seized but soon let alone, and then *Eristalis*. They were left untouched. Their resemblance to the bees was protective. Later I gave *Eristalis* again, and induced one of the chicks to seize it by pecking at it with my pencil. He ran off with it, chased by others. It was taken from him and swallowed. The other *Eristalis* insects were left untouched, but one was subsequently eaten.

Ducklings.—I placed some frog tadpoles in their water. They were soon spied and eaten greedily. The vulgarity of the duckling as a feeder is painful to witness.

SIXTH DAY.—*Chicks.*—I gave them their tin without water. They stood in it and pecked, one lifting its head. They scratched at the bottom vigorously, and pecked again and again. On this day they frequently stood up, stretching out their necks and fluttering their wings. They may, however, have begun to do this earlier. Several of them pecked at a sleepy wasp, but soon let it alone. I made a number of experiments on this and the previous day with regard to their ability to catch flies on the wing, placing the insects under a tumbler. The birds pecked at them as seen through the glass. I then let them, one by one, escape. The chicks made a dash at them, but never succeeded in catching one, though they caught one or two as they crawled out and before they had taken flight. I tried also with tumblers covered with cards. I may add that up to thirteen days I have never yet once seen a fly captured on the wing by either a chick or a duckling, though I have often seen them struck at.

Ducklings.—Each morning, at nine o'clock, I had placed in their pen a large black tray, and on it a flat tin containing water. To this they eagerly ran, drinking and washing in it. On the sixth morning I gave them the tray and tin in the usual way, but without any water. They ran to it, scooped at the bottom, and made all the motions of the beak as if drinking. They squatted in it, dipping their heads and waggling their tails as usual. For some ten minutes they continued to wash in non-existent water (association). I then gave them water. I threw them a bee: one of them seized it and swallowed it. Possibly he was stung. He kept on scratching his beak—first on one

side, then on the other, and seemed uneasy. He was all right again, however, in half-an-hour, but did not seem keen after a bee I offered him; nor would he take any notice of an *Eristalis*.

Seventh Day.—*Chicks* (Group A).—I threw in a number of bits of red-brown worsted, one to two inches long. They were seized with eagerness and eaten with avidity. I could not satisfy them with worsted worms, and desisted in the attempt lest the diet should produce unpleasant effects on their little gizzards. I left, however, one four-inch worsted worm, of which the chicks seemed afraid. Presently the bolder one seized it, ran off with it chased by the others, escaped from the pen, reached a secluded corner of my study, and with great efforts swallowed it to the last half-inch. The same chick pecked repeatedly at something near the corner of the turned-up newspaper which then formed the wall of my pen (I now use wire netting). This I found to be the number of the page. He then transferred his attention to the corner of the paper, which he could just reach. Seizing this he pulled at it, bending it down and thus forming a breach in the wall of my experimental poultry-yard, through which he escaped. I caught him and put him back near the same spot. He went at once to the corner, pulled it down, and escaped. I caught him and put him back on the other side of the pen. Presently he sauntered round to the corner, began pecking again, and escaped. I then pulled it up out of his reach. He pecked at it, but soon desisted. This is a good, simple example of the intelligent utilisation of a chance experience. Group A, including this chick, were near the close of their seventh day returned to the yard from which the eggs were obtained through the kindness of my friend, Mr. John Budgett. They were adopted by a broody hen, and were reported to seem afraid of her.

Very noticeable at this stage is the effect of any sudden noise—a sneeze, clapping one's hands, a sharp chord on the violin; or of suddenly pitching among the chicks a piece of screwed-up paper. They scatter and crouch, or sometimes simply crouch down where they are. The constant piping cheep-cheep ceases, and for a moment there is dead stillness, each bird silent and motionless. In a minute or so, up they get and resume their cheeping notes.

Ducklings.—I repeated the experiment with the dry tin. Again they ran to it, shovelling along the bottom with their beaks and squatting down in it. But they sooner gave up the attempt to find satisfaction in a dry bath.

Eighth Day.—*Chicks*.—On this day I noticed for the first time the chicks crouching down and making all the movements of sand-washing or dusting themselves in the way many birds affect. There was only a little sand strewn over the newspaper and not much good came of the operation. Still it was persisted in for a quarter of an hour at a time. I tried these too (Group B) with worsted worms. They seemed to give complete satisfaction, and there was many a

stern chase after the fortunate possessor of an inch of worsted. I tried them again with cinnabar caterpillars, of which they took scarcely any notice. None were seized. I threw in a lump of sugar. The chicks stood round it, uttering the danger note. Then some ran at it, pecking rapidly and withdrawing in haste. They deal thus with moderate-sized suspicious-looking objects.

Ducklings.—On repeating again the experiment with the empty tin they soon left it, and did not squat down in it at all. But when I poured in water they ran to it at once.

TENTH DAY.—*Chicks.*—I took two of the chicks to the yard from which the eggs were obtained, and opened the basket, in which I had carried them, about two yards from a hen which was clucking to her brood. They took no notice whatever of the sound. They were not in a frightened condition, for they jumped on my hand and ate grain off it, scratching at my fingers. I put them with a hen in a small fowl-house. They did not seem frightened, or, if at all, but little. To those that remained I took back a large humble-bee. One darted at it, giving it a sharp peck, and throwing it disabled to one side.

Ducklings.—One of the ducklings seized the disabled bee, and, after mumbling it for some time in the water, swallowed it.

THIRTEENTH DAY.—I took the remaining chicks to the yard. A hen in a fowl-house was clucking eagerly to her young brood. The chicks were put down outside, out of sight of her. They took no notice whatever of the clucking sounds she made, but scratched about round me. They were then placed among her brood. She seemed inclined at first to drive them away, but afterwards looked more kindly on them. But they did not keep close to her like her own brood. I went over to see them next day. One was at some little distance from the hen. I leant down and held out my hand. The little thing ran to me and nestled in my palm.

The sounds emitted by the chicks are decidedly instinctive, and some of them are fairly differentiated. At least six may be distinguished. First the gentle piping, expressive of contentment. It is heard when one takes the little bird in one's hand. A further low note, a sort of double sound, seems to be associated with extreme pleasure, as when one strokes the chick's back and cuddles it. Very characteristic and distinct is the danger note—a sound difficult to describe,—perhaps somewhat as if a miniature policeman's rattle were sprung inside the chick's head. This is heard on the second or third day. If a large humble-bee or a black-beetle, or a big worm or lump of sugar, or in fact anything largish and strange be thrown to the chicks, the danger note is at once heard. Then there is the cheeping, piping sound, expressive, apparently, of wanting something. It generally ceases when one goes to them and throws some grain or even stands near them. My chicks were accustomed to my presence in the room, and generally were restless when I left them and made this sound. Then there is the sharp squeak when one seizes them

against their inclination. Lastly, there is the shrill cry of distress when, for example, one of them is separated from the rest. I have very little doubt that all of these sounds have, or soon acquire, a suggestive value of emotional import for the other chicks. Certainly the danger note at once places others on the alert. But the suggestive value seems to be the result of association and the product of experience.

The foregoing observations I have presented much in the form, though with many omissions, in which they were noted down at the time; hence much crudity of expression. They appear to me to suggest—

(1.) That there are many truly inherited activities performed with considerable but not perfect exactitude in virtue of an innate automatism of structure.

(2.) That associations are formed rapidly and have a considerable amount of permanence.

(3.) That intelligent utilisation of experience is founded on the associations so formed; such associations being a matter of individual acquisition, and not of inheritance.

(4.) That there is no evidence of instinctive knowledge, even in a loose acceptation of this word. This follows from the non-inheritance of associations of impressions and ideas. *Co-ordination of activities* is thus apparently inherited, but *not correlation of impressions and ideas.*

(5.) That even the inherited co-ordinations are perfected and rendered more effective by intelligent guidance.

(6.) That imitation is an important factor in the early stages of mental development.

(7.) That the inherited activities on their first performance are not guided by consciousness, though they are probably accompanied by consciousness. The *rôle* of consciousness is that of control and guidance. Only on the first performance of an inherited activity is the chick a conscious automaton. In so far as the activity is subsequently modified and perfected by intelligence the agent exercises conscious control. If we then term it an automaton, we must admit that the automaton has a power of control over its actions in accordance with the conscious concomitants of certain cerebral changes. Into the physiological mechanism of control, as I conceive it, I cannot enter here.

C. Lloyd Morgan.

SOME NEW BOOKS.

THE PSYCHOLOGICAL REVIEW. Vol. I., no. 1, January, 1894. New York and London: Published bi-monthly by Macmillan & Co. Single numbers 75 cents. Annual subscription 4 dollars.

THIS new periodical makes an excellent start, including long contributions from Professor Ladd (his Presidential Address to the New York Meeting of the American Psychological Association), from Josiah Royce on "The Case of John Bunyan." Hugo Münsterberg sends the first of a series of studies from the Harvard Psychological Laboratory. Mr. Francis Galton has a note on "Arithmetic by Smell." Professor James discusses Wundt on "Feelings of Innervation" and the other articles and reviews are well up to the standard implied by the foregoing.

Professor Ladd's Presidential Address is very interesting. He discusses first the burning question of the relation of Laboratory work in physiological psychology to the general subject. He extends a generous welcome to the young science, but deprecates that ardour of its votaries which sees science in no other method. No doubt Professor Ladd holds rightly that scientific psychology must include not only laboratory work but introspection and "reflective study of that artistic delineation of soul-life in which the best novels, poems, and dramas are so wonderfully successful." But it is not good that all truths should be blazoned abroad and in those sciences that have a side open to the inexact and the amateur, it is specially necessary to distinguish between those who write about things and those who work at them. For this reason our sympathies are with those who insist on the laboratory and the methods of the laboratory. For similar reasons our sympathies are again with the experimental school in the endeavour to get at objective conclusions in psychology. No doubt the result of "series" of experiments and generalisations from statistics must be interpreted in terms of consciousness. But that, in a sense, is true of all science, and though the materials of psychology are peculiarly changing, evanescent, complex, personal, laboratory work has shown already that objective truths can be reached. There is no need to insist upon introspection: we all "introspect": perhaps we all must do it, but there is need to insist upon exact methods.

Professor Ladd's treatment of the relation between science and philosophy is very interesting. He traces the events leading to he relation of mutual contempt in which the two subjects stood twenty years ago, and although at the present day "reconciliations" are chiefly effected by "men of second-rate quality," he approves of the spirit. "For philosophy is but wild and mischievous speculation, unless it build itself upon the concrete and particular sciences; and science is but the unsatisfying husk of knowledge, is without rational self-consciousness and highest import and divinest interest, unless it intelligently lend itself to help, and to be helped by, philosophy."

P. C. M.

A THEORY OF DEVELOPMENT AND HEREDITY. By Henry B. Orr, Ph.D., Professor at the Tulane University of Louisiana. New York and London: Macmillan and Co., 1893. Price 6s.

AT the present time all theories of Development and Heredity are classified naturally in accordance with the views of the writers about the inheritance of acquired characters. Professor Orr accepts the principle of such inheritance but he is somewhat cavalier in his treatment of the question. He compares one-celled animals with many-celled animals from the "physiological" point of view, and comes to the conclusion that there is no sure foundation for the assumption of a physiological difference between the great groups. In the one case the mass of protoplasm is continuous: in the other the protoplasm is intersected by cell-walls, running in all directions. "In the simpler forms of the metazoa each cell has a nucleus: in the more complex of the protozoa a single-celled animal may have several nuclei. Thus we see that the nucleus affords no basis for the assumption of such a profound distinction between the groups." Cell-walls (primarily, at least) are merely "an indispensable means of support." "None can maintain that the sluggish Hydra is a more highly-developed organism than the graceful Stentor or Paramœcium." In higher animals the complicated nerve-tracts place the organs in a more immediate connection with each other even than the protoplasm in the cells of Hydra. It is true, he admits, that metazoa differ from protozoa in that they have germ-cells. But these are merely part of the protoplasm which retains its original qualities, "only changing its nervous condition to a condition of greater complexity of co-ordinations." The germ-cells are, therefore, able to develop as did their forbears, with the addition of the "nervous" changes impressed on them by the forces of the environment. Professor Orr gives instances showing that the germ-cells are not isolated from the rest of the organism; instances like the effects on the body of castration; instances like changes of season determining the period of maturation. But hear the Professor:—

"Finally, since the germ-cells possess the potentiality of producing all the nervous and mental traits of the body from which they are derived, we cannot suppose them utterly disconnected from the nervous system and inaccessible to its influence. There seems to be a most profound and intricate connection between the two.

"We find, therefore, no essential difference between the development and reproduction of the protozoa and the same process among the metazoa. If inheritance of acquired characters be admitted for unicellular organisms (and I can see no other reasonable interpretation of the fact), then the same must be admitted for multicellular organisms."

Biology, according to the Professor, stands between the science of physics and psychology, and the laws of these cannot be neglected in biological research. The forces of growth and development must be regarded as transformations of the general sum of energy. Starting from this he builds up a theory that is epigenetic in the extremest form. It is the pressure of the outer world that moulds and forms the growing organism. Light and heat, vibrations and impacts, the chemical and physical nature of gases and food-substances, are the active forces at work, and by them protoplasm becomes organism. Some examples will show the extent to which Professor Orr attributes direct mechanical effect to the environment. The fauna of the Gulf Stream are *all* yellow because the seaweed in which the animals live is yellow, and living matter is capable of photographing colours: so

also with the tawny animals of the desert. Nerves are formed because nervous molecular impulses seek the channels of least resistance: and by repeated passing through the same channels, cause a differentiation of the tissue. Cave animals are blind because the eyes of many generations "have never been stimulated to their full growth by light."

Psychology contributes to the theory, the laws of Association and Repetition. Professor Orr believes that the nervous system is merely a specialisation of the nervous activity of cell-protoplasm, and so cheerfully applies to all living matter considerations drawn from psychological observations on human beings. The simplicity of the theory consists in this: if you assume that outward forces are the "cause" of growth and development, and that molecular changes corresponding to memory of growth and development are transferred to the germ-cells, it is quite clear that under similar forces the germ-cells will be changed in the same way: only they will be changed more quickly, because they know what they are bound to do.

P. C. M.

INVESTIGATIONS ON MICROSCOPIC FOAMS AND ON PROTOPLASM; Experiments and Observations directed towards a Solution of the Question of the Physical Conditions of the Phenomena of Life. By O. Bütschli, Professor of Zoology in the University of Heidelberg. Authorised translation by E. A. Minchin, B.A. (Oxon.), Fellow of Merton College, Oxford. 8vo. London: Adam and Charles Black, 1894. Price 18s.

SOME time ago[1] in an account of the original German edition of Professor Bütschli's work, I was able to let readers of NATURAL SCIENCE know that an authorised translation by Mr. Minchin was in preparation. This has now appeared, and the publishers, the translator, and Mr. Minchin are to be congratulated. Only those who have had to grapple with the perplexing German of the original can appreciate how lucidly and how skilfully Mr. Minchin has interpreted his author. In *format* the book is an improvement on the stitched German quarto; the plates have lost nothing in the transference, and the convenience of the reader is consulted by the relegation to smaller type of some discursive controversial matter.

It is needless to describe at length a book which biologists have now no excuse for neglecting. Professor Bütschli, in the course of his well-known investigations on Protozoa, came to see that there are all gradations between scattered vacuoles and a completely alveolar or reticular structure. He was led in this way to interpret all reticular structure in protoplasm as honey-combed structure. Then, after patient effort, he succeeded in manufacturing microscopic foams that, under the microscope, presented the reticulate appearance of protoplasm. In this book he describes these foams minutely and compares them with protoplasm as seen in many organisms. But an unexpected marvel was the appearance of streaming movement and actual progression in his artificial foams. The discussion and physical explanation of these, and the suggestions these physical explanations give for the analogous processes in living material, form the most startling part of Professor Bütschli's contribution to science. These are all matters to be worked out with microscope and materials, rather than to be discussed and criticised in writing. Do not reason with a doubter, using vain words, but lead him to a laboratory and show him the foams streaming and moving. P. C. M.

[1] NAT. SCIENCE, Jan., 1893, "Artificial Protoplasm," by P. Chalmers Mitchell.

'Mongst Mines and Miners; or Underground Scenes by Flashlight: a series of photographs with explanatory letterpress, illustrating methods of working in Cornish mines. By J. C. Burrows and William Thomas. 4to. Pp. 32, 27 photographs, and vertical plan of workings of the Dolcoath Mine. London: Simpkin, Marshall & Co., 1893. Price 21s.

This book is most interesting. Apart from its peculiar value as a faithful record of the method of working a mine, it gives the reader a good idea of the difficulties to be overcome in winning metals. Mr. Burrows has spent a twelvemonth in producing the twenty-seven excellent photographs contained in the book, and gives a lively picture of the patience necessary to enable one to become a successful photographer of underground mining scenery. The apparatus used was a Zeiss' Anastigmat lens, series iii. (Ross & Co.), and the artist enthusiastically terms it "a perfect gem." Of the many plates used, none equalled the Cadett lightning plates, which proved so satisfactory that in some cases every miner was taken in his working position with his light in its usual place. For illumination, limelights at their maximum intensity had to be employed simultaneously with powerful flash magnesium lamps and ribbons. For close subjects two triple-flash magnesium lamps were generally used, but in large areas more lamps were brought into requisition. The mines chosen for illustration in this work are the Dolcoath, Cook's Kitchen, East Pool, and Blue Hills. The photographs themselves, which are described by Mr. Thomas, include views of the man-engine at Cook's Kitchen and Dolcoath; the balance box and gig at Dolcoath; the 355 and 406 stopes at Cook's Kitchen; the 180 at East Pool; the 375 and the 412 at Dolcoath, and the 66 at Blue Hills; the 70 tram-road and the bridge, East Pool; engine shaft at Cook's Kitchen; the heave at Blue Hills; rock-drilling, milling, overhand and underhand stoping, and a group of miners at "croust," or afternoon meal.

The photographs are excellent, and most detailed; in those cases, too, where the men are holding candles the flame is seen to be perfectly distinctly outlined. We congratulate both artist and author on the results of their patient but enthusiastic labour.

The Oxford Museum. By Henry W. Acland, M.D., and John Ruskin, M.A. 8vo. Pp. xxxvi., 112, two plates, and folding plan. From original edition, 1859. With additions in 1893. London and Orpington: George Allen, 1893.

To all Oxford men, to all scientific men, to all artists, architects and craftsmen, to all who have any sympathy with either nature or art, this book comes fraught with stirring and pathetic interest. The book itself is professedly an address delivered by Sir Henry Acland, in 1858, to certain Architectural Societies, on the building of the Oxford Museum. But admirable though this address is, it is, we venture to think, in that which has grown around it, in the letters of Mr. Ruskin, in the notes and in Sir Henry's preface to the present edition, that the chief interest of the book will now be found. We have here a double story: the story of the revival of Gothic architecture, and the story of the progress of scientific education in an old university; and the two stories are bound together by the impressive personality of John Ruskin. How the Museum gradually came to be, and how it rose beneath the enthusiastic hands of an artistic band of Irish craftsmen, is a tale delightfully told in this volume. Then with wonderful delicacy and tact Sir Henry relates the causes that led to Mr. Ruskin's resignation of his professorship when Convocation voted

£500 a year for carrying on the work in Dr. Burdon Sanderson's Physiological Laboratories. Sir Henry regrets that no living plants or animals are kept in connection with the Museum. "Life in action, with the habits thereto pertaining, is a study as worthy as is the machinery which makes, preserves, and brings it to a close. It is a fault in most museums that only the mechanism of life and not its living actions are displayed."

What follows is of sufficient importance at the present juncture to quote in full. "These general thoughts may seem strange to those in Oxford who, from imperfect knowledge, desire to change the Museum into a so-called 'medical school.' They perhaps have not reflected on the loss that they will inflict on the Profession of Medicine if they succeed. Forty years ago it was hoped to add to the wide Philosophical, Historical, Theological life of the old University the means for similar study of the material Universe considered alike in its Unity and in its special parts. It was felt that this would harmonise with, and supply the missing link in the aims of the old education. The opportunities were to be open to all, for whatever walk in life destined. Adapt it only to one profession such as medicine, you rob all others of the larger opportunity, and—what is even worse—persuade future Oxford graduates that medicine has no relation to science as a whole; that it is a specialism, grounded on itself alone, and that the essence of its education is to prepare by schedules for passing examinations. No greater educational fallacy can exist. To give colour to it is a cruelty to all our youth. Our best students already feel this to be so. The foundation by them of the Robert Boyle Lecture is a proof. Wider views are held by the best thinkers, even for our elementary and Government schools. The conception is a relic of days of ignorance."

Like all works to which Mr. Ruskin's name is attached, this one is beautifully produced. One of the two exquisite plates represents the capital of a pillar in the central court of the Museum, while the other is a charming portrait of the two authors.

NOVITATES ZOOLOGICÆ: A Journal of Zoology. Edited by the Hon. Walter Rothschild, Ernst Hartert, and Dr. K. Jordan. Vol. i., no. 1. Imp. 8vo. Pp. 266 and three plates. Issued January 30, 1894, at the Zoological Museum, Tring.

THIS handsome publication, to which the yearly subscription is one guinea, has been started mainly for the purpose of describing new species, and, we presume, of thereby adding to the type-specimens in the Rothschild Museum. The species-mongering is, however, not to be done rashly, or at the mere caprice of writers; it is to be subject to certain principles which are laid down by the Editors in an introductory note. "The basis of truly scientific, systematic work is the knowledge of the species and their geographical distribution. Therefore we ought to distinguish between the different forms, even if their differences are very '*slight*,' provided they are *constant*. If very closely allied forms are connected by intermediate specimens (as is often the case in the countries where their areas meet or overlap), it is practically not advisable to admit them as distinct species, but they ought to be degraded to the rank of sub-species. Island forms, however slight may be their differences, will, in most cases, be more readily recognised as worthy of specific rank than similarly closely allied forms with a mainland distribution. The term 'variety,' especially among entomologists, has been indiscrimi-

nately used to denote an individual variation within a species as well as climatic or geographical races. We, therefore, to avoid all possible errors, have determined to discard the term variety altogether. To denote individual variations we shall employ the word aberration, and for geographical forms which cannot rank as full species, the term sub-species."

The present number contains communications from the three editors, from Dr. Forsyth Major and Mr. W. F. Kirby, which are written in Latin, German, or English. Nothing is said as to language, but we hope Mr. Rothschild's catholicity will not include Russian or Japanese. Two of the plates are beautiful specimens of the art of J. Smit and J. G. Keulemans.

THE CRINOIDEA OF GOTLAND. Part i. The Crinoidea Inadunata. By F. A. Bather. *Kongl. Svenska Vet. Akad. Handl.* Bd. xxv., no. 2. 4to. Stockholm: 1893.

THE Silurian beds of the Isle of Gotland have long been famous for the wealth of numbers and excellence of preservation of their fossils, ranging from the Upper Llandovery to the Upper Ludlow. Numerous monographs have appeared upon them from time to time, for they have yielded to the Swedish school of palæontology its most profitable material. The Crinoids have been elaborately figured in the great folio "Iconographia Crinoideorum" of Professor Angelin in 1878; and probably no one who has had occasion to use that work but has felt that it is not a fair specimen of Swedish science; the death of the author before its completion probably accounts for many of its errors. The unsatisfactory nature of Angelin's posthumous monograph has been the more regretted owing to the singular wealth and interest of the Gotland Crinoids. Students of Echinodermata will therefore welcome the first of a series of detailed memoirs on these fossils from the pen of Mr. F. A. Bather.

This first part deals only with the Inadunata, the Order in which all the brachials are free and the interradials do not take part in the composition of the dorsal cup except in the posterior interradius. The memoir consists of 200 pages, and 10 admirable plates, crowded with instructive and artistic figures by Mr. Liljevall. With the exception of a few introductory pages, which deal with the terminology, bibliography, and stratigraphical horizons, it consists entirely of a detailed account of the structure of the Crinoids, with discussions of the affinities and synonymy of the various species. The Inadunata in the fauna comprise thirty-nine species sufficiently well known to be described; these are referred to ten genera, and the imperfection of our knowledge of the Silurian Crinoids may be judged from the fact that these ten genera are referred to no less than seven or eight families. Of the species fifteen are new, and there is one new genus appropriately named *Gothocrinus*.

The present, however, is not a work to be judged by the number of species created; it is in its detailed dissections and figures, its precision of nomenclature, the care that has been taken in determining the morphological meaning of the different elements of the skeleton, and the patience with which the nomenclature and synonymy have been discussed, that its real merit lies. Forms such as *Pisocrinus* and *Calceocrinus*, that have been previously turned upside down, wrong side before, or inside out, to suit the varying explanations of their describers, are now finally explained, owing to the recognition of the anal tube. The curiously coiled *Herpetocrinus* is also now first satis-

factorily worked out. One of the most remarkable innovations is the abandonment of the two suborders Larviformia and Fistulata, which have always seemed unsatisfactory on *à priori* grounds, and a return to a classification based on the presence or absence of infra-basals. The author admits that this may seem a retrograde step, but as in this mixed world advance does not always spell progress, it is, probably, none the worse for that.

In a brief notice such as this, one can do but scant justice to this important contribution to palæontological literature. It is unfortunate that it is impossible to get such a work published in England, and that this has had to see the light in a foreign capital. One's patriotism, however, has to get what salve it can from the recognition that this is not a sample of the rule-of-thumb palæontology which foreign workers seem generally to regard as the characteristic product of the English school. The "Crinoidea of Gotland" is worthy, by its conscientious thoroughness of detail, and its grasp of zoological principles, to rank among the best productions of modern palæontology.

THE FLORA OF THE ASSYRIAN MONUMENTS AND ITS OUTCOMES. By E. Bonavia, M.D. 8vo. Pp. xxvi., 215, with 98 figures in the text. Westminster: A. Constable & Co., 1894.

DR. BONAVIA'S books are always worth reading. Even when he puts before us no new facts, he has a way of restating the old ones which is sometimes edifying, sometimes amusing. In the preface to this, his latest work, he has attempted "from the Assyrian real flora, to creep up to their sacred flora, and to interpret certain symbols found woven in with this." He may have succeeded also "in throwing some light on the derivation of other features affiliated to those symbols." He would also have us bear in mind that whenever it may appear that he is too positive in what he states, it is only a mode of diction, and simply means that in his "humble opinion it seems so and so." As regards the Flora of the Assyrian monuments in the British Museum and elsewhere, some plants are unmistakable, as for instance the date-palm, which frequently occurs, and no wonder, considering its immense importance as a food tree, and the reverence paid to it in consequence. The vine, pomegranate, and fig are also easily recognised. Some things looking much like bundles of asparagus are put down for bananas, and we certainly think the doctor makes out a very good case, showing from the geographical and botanical history of the plant that this fruit may well have been known to the Assyrians as an imported and rare article. This also explains why only the fruit and not the plant itself is traceable on the monuments. The pine tree which occurs on several bas-reliefs is identified with *Pinus Brutia*, a conifer, ranging nowadays from Syria to Afghanistan, and most likely to have been the one which was common in the hilly countries of Assyria. "A *young* pine tree, with its symmetrical, candelabrum-like branches . . . makes a very pretty and ornamental object, and such as would attract an artist's attention." The sculptors of those days were also acquainted with a lily, which is identified with the "Madonna Lily" (*Lilium candidum*). A plant with acute radical leaves, and long-stalked, composite flowers, has by the aid of the collection of drawings at the British Museum (Natural History) been run down to *Hieracium pannosum*, a native of the rocky regions of Greece, Taurus, Cilicia, South Armenia, etc. It certainly looks like

a Composite, but he would be a bold man who would accept a specific determination made on such material and in such a very critical genus as *Hieracium*. Another thing, not unlike a sea-weed, "the identification of which appears to be hopeless," Dr. Bonavia suggests as not impossibly intended for the Baobab, a tree found in the Soudan and S.E. Africa, and introduced, perhaps, along with ivory and many other products, which must have come from the Soudan *viâ* the Red Sea.

Out of the study of the Flora arises the question of the origin of the so-called Sacred Trees, of which four or five different kinds are traceable on the monuments, viz., the date, vine, pomegranate, fir, and perhaps the oak. This leads us on to the cone-shaped object, "held in the hand of winged genii, and pointed either at a sacred tree or at the king's person, or at the entrance of a temple, palace, or town." In the other hand the genius invariably holds a bucket of some sort, and in the bucket the worthy doctor finds the key to the situation. After rejecting his own notion of the citron, and also Dr. Tylor's theory, that the cone is the male inflorescence of the date-palm, of which a further supply was contained in the bucket or basket, and that the pointing indicates fertilisation of the sacred tree, the author suggests an explanation to which he does "not see sufficient grounds for not adhering." It is that the bucket contains holy water and the cone-object represents a *cedar*-cone, used as a sprinkler. This will explain the pointing at the king's back hair and other objects besides the date-palm. As we are barely half through the book, we cannot stay to evolve a more satisfactory solution. In the next section the Lotus as a decorative object is discussed with a protest against viewing all ancient ornamentation through "lotus-spectacles." The "Anthemion," it is argued, originated in the sacred date-tree of the Assyrians. Apropos of "the Evil Eye" it is suggested that the Prince of Wales's feathers may have originated from a pair of horns (a protection against the aforesaid eye) and three date-palm leaves.

The last two sections of this very readable and well-produced work are entitled "The Trident" and "Some Notes on Cylinders."

THE GENUS MASDEVALLIA. Issued by the Marquess of Lothian, plates and descriptions by Miss Florence H. Woolward. Folio. Part v., containing ten species and varieties. London: Porter, 1893. Price £1 10s.

WE congratulate the authors of this admirable monograph on the completion of the fifth part of their undertaking, which must bring them about half-way through, as fifty species and varieties have now been figured and described. We are inclined to think the present the most interesting of any of the parts which has yet appeared. It certainly is so from a scientific point of view, as it contains a complete history of *Masdevallia uniflora*, the first Masdevallia made known to science, discovered more than a hundred years ago in the Peruvian Andes by the Spanish botanists Ruiz and Pavon, and named in honour of their fellow-countryman, Dr. Josepho Masdevall, a physician and a patron of botany. It was found only in one locality, of which a description is given by Ruiz in his manuscript diary preserved in the Botanical Department of the British Museum. Huassa-huassi, as it is called, was then a small village of about forty inhabitants, situated in the depths of a steep narrow ravine, on the banks of a mountain torrent of the same name; the slopes around were covered with brilliant flowering plants, among which orchids abounded, their

bulbs crowding the entire surface of the driest and most rocky grounds while the air was filled with the fragrance of their strange and elegantly shaped flowers. In spite of this promising description Huassa-huassi has, so far as we know, never since been visited by any botanist, nor has *M. uniflora* again been gathered. The species has never been in cultivation, and until Miss Woolward made it a subject of study there was no specimen in the country. The graceful drawing of the plant which accompanies the text is taken from the better of two of Ruiz and Pavon's specimens preserved in the Museum at Madrid; a third, consisting of two leaves and a bud from the same collection, was given by the Director, Dr. Colmeiro, to Miss Woolward, and by her to the Botanical Department of the British Museum. The fourth, and the only other specimen known, is now in the Boissier Herbarium at Chambésy. It formed part of a valuable collection of dried plants belonging to Pavon, discovered after his death by Mons. Reuter, hidden away in a garret in Madrid. Reuter purchased the collection for the Boissier Herbarium, of which he was then curator, and the orchids were submitted for examination to the late Professor Reichenbach who redescribed *M. uniflora* in "Bonplandia" (1856). Besides the small specimen from Madrid, Miss Woolward has also given to the British Museum the original sketch of the larger Madrid specimen, and one of the plant in the Boissier Herbarium.

Part V. also contains plates and descriptions of two Brazilian species not hitherto figured, and quite unknown in Europe. They were found by Senhor Barbosa Rodriguez, Director of the Botanic Gardens at Rio Janeiro, to whom the authors are indebted for the originals of the plates and the information in the text.

Several other species are also figured for the first time, and the Part opens with a splendid double plate of the gorgeous *M. chimæra*.

ZITTEL'S HANDBOOK OF PALÆONTOLOGY.

THE recent appearance of the concluding fasciculus of Professor von Zittel's "Handbuch der Palæontologie," coupled with the circumstance that the Council of the Geological Society have, most worthily, just bestowed their highest honour—the Wollaston Medal—on its learned author, affords us a fit opportunity of congratulating both the Professor himself and his enterprising publishers on the conclusion of their labours. As we have from time to time noticed some of the fasciculi which have appeared since this Journal came into existence,[1] while the limits of our space entirely forbid any detailed notice of the earlier volumes, we must content ourselves on this occasion with offering our most unqualified congratulations on the completion of the work.

It has been frequently remarked that Science has had many martyrs, and in our day the chief of these are unquestionably the compilers. Compilation is, indeed, work which, owing to the vast flood of scientific literature now poured forth without any system of publication, and in a confusing Babel of tongues, becomes year by year more necessary and more difficult. If there are few men who are willing to abandon original research, with its bracing stimulus of effort and novelty, for the duller plodding work of preparing summaries, there are still fewer capable of accomplishing this in a satisfactory manner, more especially in such a difficult science as palæontology, where so much is uncertainty and speculation.

[1] *See* NATURAL SCIENCE for March and September, 1893.

Such a compiler must be master of many languages, for most States have their own Geological Surveys, and publish reports in their own dialects, however obscure these may be. He needs great patience and capacity for work to enable him to grapple with the enormous volume of literature, combined with considerable elasticity of mind to avoid treating foraminifera and mammoths alike; he requires literary ability for lucidity of exposition and accuracy of diagnosis; he must be thoroughly well versed in zoological methods of enquiry, and completely *au fait* with the rules of zoological nomenclature; while, above all, he must be a sound geologist, fully in sympathy with and conversant with the needs and work of his fellow-labourers in the field. If any of these qualities be lacking the chances are that he will do as much harm as good, and have thrown himself in vain under the Juggernaut car of periodical literature.

It is doubtful whether any other man could be found possessing these qualities in a higher degree than Karl von Zittel, the Professor of Palæontology in the University of Munich, a brilliant linguist, a masterly teacher, a field-geologist of wide experience in Europe, Africa, and America. Uniting the laborious patience of a North German with the imagination of a Bavarian, he possesses all the qualifications necessary for the compilation of a reliable summary of contemporary palæontology. For the last eighteen years he has been engaged upon the task which he has now brought to a conclusion.

The "Handbuch der Palæontologie" is divided into two parts or sections; the first, in four volumes, dealing with the animals, being by Professor von Zittel himself, while the latter, in one volume, describing the plants, was commenced by the late Professor Schimper of Strassburg, and concluded by Professor Schenk, of Leipsic. The part on the animals alone occupies four thick volumes, containing a total of no less than 3,364 pages, with upwards of 2,976 illustrations. The first part was issued in 1877, and the last at the close of 1893. Although a work which has necessarily been such a long period in progress has some portions standing in need of revision, it will be found to contain a complete and reliable summary of the state of our knowledge of extinct animal and vegetable life at the time when the several parts respectively made their appearance. The first volume contains the general introduction, the Protozoa, Cœlenterata, Echinodermata, Bryozoa, and Brachiopoda, the second describes the remaining groups of the Invertebrates, the third the Fishes, Amphibians, Reptiles, and Birds, while the fourth is devoted solely to the Mammals.

Not only is the work issued in the original German, but, with commendable promptitude, four volumes have already been translated into French by Dr. C. Barrois, with the aid of other specialists: these four volumes respectively made their appearance in 1883, 1887, and 1891, and only the one devoted to Mammals remains to complete the French issue. It cannot fail to be a matter of regret that there is no prospect of any English translation being presented to the public; and we fear that the remark of a late President of the Geological Society to the effect that "no English publisher at present would feel justified in undertaking" the task, is only too likely to prove true.

The description of each separate order commences with a general account of the anatomy, the structure of the skeleton, and a sketch of its distribution in time. The main part of the work consists of more or less detailed systematic description, the whole of such families as

have fossil representatives being included; while short diagnoses are given of all genera of any palæontological importance. The work, therefore, is an almost complete synopsis of the whole range of palæontology.

The "Handbuch" is, however, by no means merely a compilation. Professor von Zittel has always shown himself far too conscientious a worker to be willing to be content to leave some of the groups he has had to treat in the state of hopeless chaos in which he found them. In nearly every group the author's acumen in interpreting the descriptions of others, or his researches on the very extensive collections at Munich, have considerably advanced the classification. Take, for example, the Sponges; before the author came to them in the preparation of his second "Lieferung," they were in absolute chaos, the descriptions being based almost entirely on points of such little scientific value, that it was totally impossible to make any satisfactory comparison of the fossil with the recent faunas. The author accordingly at once commenced a re-investigation of the group and devoted nearly two years to the eighty pages in which the Sponges are described; by the study of thin sections under the microscope the forms of the spicules were determined and our knowledge of the fossil sponges placed on a scientific basis. In other groups there was less room for such revolutionary changes; but there are few, if any, which Professor von Zittel has left where he found them. In the Echinoidea he founded the family Conoclypeidæ after a study of the internal structure of the peristome, and thus removed one stumbling-block from the path of echinologists. The classification of the Bryozoa was extremely advanced considering that it was prepared fourteen years ago, while many very sound advances were made in the complicated synonymy of this group.

In the Vertebrates, which, we believe we are right in saying, are not his speciality, the Professor has in the main followed the classifications of those who have made studies of the various groups. Even here, however, he at times strikes out a line of his own. Thus, as we have had occasion to mention in our previous notices, he divides the Mammals into the Placental and Eplacental groups, of which the latter includes both Monotremes and Marsupials; while in the Ungulates many modifications have been made (whether wisely or unwisely we do not care to discuss on this occasion) in the limits of family groups.

Perhaps the most valuable contribution which Professor von Zittel has made to this part of his subject is the masterly essay on the geological distribution and evolution of the Mammalia with which the last volume closes.[2] In the two preceding numbers of NATURAL SCIENCE certain remarks from the pen of an independent observer have been made in regard to the improbability of the extinct mammals of Patagonia being of lower Eocene age; and it is interesting to note how Professor von Zittel's observations support the view there taken. Thus, the Professor remarks how difficult it is to believe that mammals with such specialised dentition as those in question could by any possibility be correlated with those of the European lower or middle Eocene, and how much more closely they resemble in their grade of evolution those of the upper Eocene or Oligocene; more especially as they are accompanied by at least one

[2] Dr. G. J. Hinde translated this essay into English and published it in *Geol. Mag.*, Sept., Oct., and Nov., 1893.

existing genus.[3] If he had had the opportunity of knowing that the alleged commingling of Dinosaurian and Mammalian remains does not appear to be founded on facts the author's remarks might possibly have been still more decisive.

To proceed further in pointing out the merits of this unrivalled Compendium of Palæontological Science would, as we have said, far exceed the limits of our space, and we can, therefore, only conclude by stating that, in our opinion, Professor von Zittel and his two colleagues have succeeded in carrying out and completing their arduous task in a manner worthy of the highest admiration, and have produced a work of inestimable value not only to the palæontologist, but likewise to the zoologist generally.

An important paper on fossil vertebrates comes to us from France. In the *Annales des Sciences Naturelles* (*Zoologie*), Mr. Filhol describes remains from the Quercy Phosphorites, which he considers to be those of true Edentates. They include (1) a form, *Necromanis*, related to the Pangolins of the Oriental and Ethiopian regions, and with a skull approaching in some respects that of the South American genus *Myrmecophaga*; (2) *Palæorycteropus*, allied to *Orycteropus*, which is now found only in South Africa, though during the Pliocene period one species occurred in Samos and Persia; (3) *Necrodasypus*, related to the Neotropical Armadillos, and represented by a portion of a carapace said to resemble that of the Glyptodonts. These discoveries and determinations tend to show that the Edentates must have had a northern centre of distribution; consequently they are of great importance, if they are correct.

In the last number of the *Quarterly Journal* of the Geological Society (1 Feb., 1894), Dr. J. W. Evans gives an account of a recent journey through the Matto Grosso district of Brazil. The ground covered by the author, which was practically the region drained by the Upper Paraguay, consisted of an undulating tableland, rising in some places to 2,600 feet above sea-level. The formations exposed are referred to Quaternary, Cretaceous?, Trias?, Carboniferous?, Devonian, and pre-Devonian. The pre-Devonian beds consist of foliated and schistose rocks, highly-cleaved clay-slates, limestones, sandstones, and red argillaceous shales. The Devonian beds are sandstones, which extend over the greater part of the Chapada Plateau, from which they take the name; and are fossiliferous near Sant' Anna de Chapada, as shown in Dr. O. A. Derby's paper (*Arch. Mus. Nac. Rio de Janeiro*, vol. ix. (1890), p. 59). The Carboniferous age of other beds is inferred from the evidence of fossil ferns found at Miranda, the authority for which evidence is quoted by Dr. Evans. The Cretaceous contains vertebrate remains, as turtles and *Mosasaurus*, the nature of which decides Dr. Derby to regard them as Cretaceous rather than Triassic. A geological sketch-map accompanies the paper.

A few days before the publication of Dr. Evans' paper, appeared part 5 of volume xxviii. of the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, containing the conclusion of Dr. Vogel's journey through the same district in 1887–88. This part of his paper consists mainly of topographical details, measurements of heights, and magnetic and meteorological observations taken during the journey. To this

[3] We may venture to point out (vol. iii., p. 738) that *Chlamydophorus*, and not *Chlamydotherium*, is an existing genus.

account is appended a paper by Dr. Ludwig v. Ammon on Devonian Fossils from Lagoinha in Matto Grosso. The specimens came from the Chapada Plateau, and consist of, among others, the trilobite *Phacops*, the gasteropod *Bellerophon* (*Bucanella*), a *Tentaculites* (*T. bellulus*, Hall), a fragment of a *Nucula*, and five Brachiopods. Of these Brachiopods one is said to be identical with *Discina baini*, Sharpe, and another with *Chonetes falklandica* (Morris & Sharpe) from the Falkland Islands, while a third is identified as *Leptocœlia flabellites* (Conrad), a North American species. Figures of these fossils are given, and Dr. Ammon notes that the beds containing them correspond to those of Ereré on the Amazonas, and to the Hamilton and Upper Helderberg series of the United States, a statement agreeing with one made by Dr. Derby in the paper referred to above.

IN the last issue of the *Quart. Journ. Micr. Sci.* (vol. xxxv., pp. 407–432), Mr. E. S. Goodrich gives an exhaustive account of all the known remains of mammals from the well-known Stonesfield Slate of Oxfordshire. From having carefully "developed" several of the specimens, the author has not only succeeded in revealing the existence of teeth supposed to be missing, but has likewise determined in others the true arrangement of their cusps. Perhaps his most interesting result is to show that *Amphitherium* had true "tritubercular-sectorial" lower molars; that is to say, these teeth had three cusps arranged in a triangle anteriorly, followed by a keel, as in the modern opossums and bandicoots. This leads him to conclude that *Amphitherium* cannot be included in the same family with *Phascolotherium* and *Amphilestes*, in which the three cusps are linear. May we ask him if he would, on the same grounds, propose to separate the existing Thylacine from the Dasyuridæ, as the difference is nearly the same in the one case as in the other? We are glad to see that the author supports, in the main, the doctrine of "trituberculism," even going so far as to derive the primitive tritubercular molar from the multitubercular type—a derivation which we are by no means sure that we are inclined to support. He totally rejects, however, the view that the so-called triconodont type of molar (that is to say, the one in which the three cusps are ranged in a linear series) is the primitive type from which the tritubercular molar was evolved. On the contrary, he considers that the triconodont is the derivative from the tritubercular. He, however, propounds this view of the specialisation of the former type as if it were a new one, instead of dating from 1887. Thus in that year Mr. Lydekker (*Cat. Foss. Mamm. Brit. Mus.*, pt. v., p. 257) wrote of *Triconodon*, "it appears to be a highly specialised primitive form, of which the lower true molars come nearest to those of *Thylacinus*, and bear the same relationship to those of *Dasyurus* as is presented by the inferior carnassial tooth of *Ictilyon* to that of *Canis*." We will not take leave of this valuable piece of work without remarking how very refreshing it is to see palæontological investigation finding place in a journal popularly supposed to be given up to the section-cutter and embryologist. We hope that a new era is being entered upon in British Palæontology, and that this publication marks a closer alliance between students of the living and students of the extinct.

WE are glad to hear that a fresh start has been made with the long-suspended and much-desired "Flora of Tropical Africa." The work was commenced by Professor Oliver, the late keeper of the

Kew Herbarium, more than five-and-twenty years ago, and three volumes were issued: vol. i. in 1868, vol. ii. in 1871, and vol. iii. in 1877. In the production of these volumes Professor Oliver had much assistance from other botanists; in fact, the last volume, which ends in the middle of the Gamopetalæ, is largely the work of Mr. Hiern. Since 1877 nothing has appeared, owing, says the *Kew Bulletin*, to the Herbarium staff being fully occupied in "keeping fresh accessions determined scientifically and incorporated," while "such extraneous aid as was available has been mostly absorbed in assisting Sir Joseph Hooker in his 'Flora of British India,' . . . and in other undertakings." Why so important a work as the "Flora of Tropical Africa" has had to await the pleasure of these other undertakings is not explained. Recent exploration and the development of commercial enterprise have at last suggested to the Government the desirability of pushing forward the work (in proof of which some three-year-old letters are quoted), a fresh start has been made, and vol. iv. is now "in active preparation." As German botanists are meanwhile rapidly describing all the novelties they can secure, it has been thought advisable to publish brief diagnoses of two new species in the *Bulletin* during the progress of the work, and the January and February numbers contain those of the orders Apocynaceæ, described by Dr. Stapf, and Gentianeæ, Borragineæ, Bignoniaceæ and Convolvulaceæ, by Mr. J. G. Baker, Professor Oliver's worthy successor.

OBITUARY.

SAMUEL WHITE BAKER.

BORN JUNE 8, 1821. DIED JANUARY 20, 1894.

SAMUEL WHITE BAKER was born in London, and was the eldest son of Samuel Baker of Lypiatt, Gloucestershire. He was educated at a private school, and afterwards went to Germany, where he studied engineering. As early as 1845 Baker went to Ceylon, chiefly for the purpose of elephant hunting. The reader of his books, however, will find that he had already taken an interest in geography, and before he left the island (1854) he had founded an agricultural settlement at Novera Elia, which he had peopled with English emigrants, and stocked with cattle mainly at his own cost.

From 1855 he superintended the construction of the Danube and Black Sea railways, and in 1861 made his first exploration in Africa, taking with him his second wife, Florence Finnian von Sass, a Hungarian lady, who has since shared all her husband's labours and enterprises. His journey had for object mainly the determination of the sources of the Nile, but partly the relief of Speke and Grant, who had left Zanzibar in 1860 with the same intent. Diverting his course in search of sport, he explored the Abyssinian rivers, and learned Arabic. Reaching Khartoum, he proceeded in 1862 southward to Gondokoro, where he met Speke and Grant in February 1863. Fired by their accounts, Baker and his wife determined to push still further, and on March 14, 1864, they reached the east side of the Albert Nyanza, and though unable to prove the exit of the White Nile, he crossed the river on his return journey about sixty miles to the north of the lake. For this adventurous journey, and its brilliant results the Geographical Society awarded Baker a gold medal. He was further created M.A. of Cambridge, and received the honour of knighthood. The story of his wanderings will be found in "The Albert Nyanza," 1866, and "The Nile Tributaries," 1867.

After a year's rest in England Baker and his wife returned in 1867 to Egypt, having in view the extinction of the slave trade. In 1868, the Khedive took Baker into his council, and it was decided that he should go, with a strong force, and absolute and supreme authority "to suppress the slave trade, to introduce a system of regular commerce, to open to navigation the great lakes of the Equator, and to establish a chain of military stations and commercial depôts distant at intervals of three days' march throughout Central Africa, accepting Gondokoro as the basis of operations." But nature and the natives were against him, and from June, 1870, to April, 1871, the expedition

suffered great hardships, and numbers died from malaria and other diseases. After reaching Gondokoro, the Bakers pushed on south, and towards the end of 1871 established a fortified camp on the Nile at Fatiko, from which he waged war unceasingly on the slave hunters, and for a time checked the trade. But so soon as he left the country the trade revived and the crusade was continued by Baker's successors. Baker and his wife returned to England in 1873, and told the story of their expedition in "Ismailïa" 1874.

Sir Samuel settled down for a while at Newton Abbot, but the old sportsman and traveller could not rest. He and his wife visited Cyprus in 1879, Syria, India, Japan, and America in later years.

His chief works, beside those referred to above, are:—"With Rifle and Hound in Ceylon," 1854; "Eight Years' Wanderings in Ceylon," 1855; "Cyprus as I saw it in 1879"; "Wild Beasts and their ways," 1890.

THE cost of African exploration has been exceptionally heavy during the past month. Mr. Ingham has been killed by an elephant owing to the jambing of his rifle on the Congo, where he had done much good work. M. Parmentier, who for several years had been one of the Belgian officials on the Upper Congo, and who added greatly to our knowledge of its geography, has died at Nice; on the very day of his death the news arrived that three missionaries in Equatorial Africa had fallen victims to the climate. The unhealthiness of this region has been impressed on the public mind by the difficulties it is placing in the settlement of Uganda. By Sir Gerald Portal's death, the malarial dysentery of the Sana has robbed the nation of a public servant of exceptional promise; Mr. Rennell Rodd, who took his place at Zanzibar, has been invalided home and cannot return to Africa. Captain Besant who had started to fill the vacancy left by the death of Sir Gerald Portal's elder brother in Uganda, has collapsed on the way, and has been brought back to the coast by Dr. Charters of the mission station at Kibwezi. The news, however, that the daring young American explorer, Mr. Astor Chanler, has succeeded in reaching Mombasa is the one bright spot on the page of disaster. He started in September, 1892, on an expedition to Fort Kenia and Lake Rudolph. His colleague, Lieutenant von Höhnel, was wounded by a rhinoceros in the thigh and had to be sent back. Shortly afterwards eighty porters who had been sent up as reinforcements with extra stores left him and returned to the coast, and this was followed by a still heavier blow as over one hundred of his original force deserted and left him in Daicho with only eighteen men.

ALEXANDER THEODOR VON MIDDENDORFF.

BORN 1815. DIED 28 JANUARY, 1894.

MIDDENDORFF was born at St. Petersburg; he studied medicine at Dorpat, where he received his doctor's degree in 1837. He completed his studies in Germany, and in 1839 was appointed

Professor at the Vladimir University, Kieff. The following year he undertook, with von Baer, a voyage in the Arctic Seas and Lapland. Charged shortly after by the Academy of Sciences of St. Petersburg, he explored Northern Siberia, and made, between 1842–1845, a difficult and perilous journey. The results of his work were given in "Voyage dans l'extrême nord et dans l'est de la Siberie" (St. Petersburg, 1848). He added to this work another dealing with the natural history and physical conditions of Russia in Asia. Returning to St. Petersburg in 1845, he became privy councillor, and was made secretary of the Academy of Sciences from 1855–57. In 1859 he was President of the Society of Economics but retired soon after, on account of ill-health to Livonia.

JUSTUS KARL HASSKARL.

HASSKARL, the botanist, died on January 5 at Cleve in the Rhine Province. He was formerly co-director of the botanic garden at Buitenzorg, Java, where he introduced the Cinchona and for some time actively superintended its cultivation. The *Münchener Allgemeine Zeitung* in announcing his death, remarks that he died in moderate circumstances, although he had been instrumental in conferring on his fellow countrymen so great a boon. He was also the author of numerous papers dealing with the Flora of India and the Malay Archipelago.

THE McGill University, Montreal, has lost a valuable benefactor in the person of Mr. PETER REDPATH, who died last month at Chislehurst, Kent, at the age of 73. Until his retirement, Mr. Redpath followed the business of a sugar-refiner at Montreal. In 1880, he founded the Peter Redpath Museum, in the grounds of McGill University, the finest Natural History Museum in Canada; and last year he presented to the University a new spacious library, capable of holding 130,000 volumes.

WE are also informed of the death of Mr. CHARLES OTLEY GROOM, who later assumed the style of His Most Serene Highness the Prince of Mantua and Montferrat. Mr. Groom left a large and valuable collection of Natural History specimens, and we understand that the cabinets of fossils and minerals have been purchased by Mr. R. F. Damon, of Weymouth.

THE following deaths are also announced: Sir HARRY VERNEY, the Father of the Agricultural Society; General Sir C. P. BEAUCHAMP WALKER, Foreign Secretary to the Geographical Society; and EDMOND FRÉMY, Director of the Museum of Natural History at Paris.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

HERR HOLST, a German botanist, has been appointed to the German station at Kilima-njaro in East Tropical Africa.

Dr. W. MIGULA, docent in Botany and Bacteriology at the technical high-school at Karlsruhe, has been raised to the rank of Professor.

PROFESSOR ENGLER, the well-known director of the Berlin Botanic Garden, has been raised to the dignity of Geheim Regierungsrath.

GEHEIMRATH PROFESSOR PRINGSHEIM, another famous German botanist, has been appointed a Knight of the Order of Maximilian and an honorary member of the Petersburg Academy of Science.

DR. W. SAPOSCHNIKOFF becomes Professor of Botany at the University of Tomsk, in Siberia.

DR. G. F. STONE has been appointed assistant Professor of Botany at the Massachusetts Agricultural College at Amherst.

MR. ALBERT F. WOODS has been appointed assistant Pathologist in the Section of Vegetable Pathology of the Department of Agriculture in Washington.

MR. W. W. CLENDENIN, formerly an Assistant in the University of Missouri, has been appointed Professor of Geology and Botany at the University of Louisiana.

AT the University of Cagliari, in Sardinia, Dr. Dominico Lovisato has been appointed Professor of Botany and Keeper of the Botanical Garden, while Dr. Francisco Sanfelice has been nominated Professor of Hygiene.

DR. GIACOMO CATTERINA has been made Assistant in Zoology and Comparative Anatomy at the Naples University.

Dr. Zacharias, late Professor-extraordinarius in Strassburg, whose recent paper on the cells of the Cyanophyceæ is of so much interest, has been appointed Director of the Botanical Gardens at Hamburg. Dr. Zacharias is a native of Hamburg, and has now returned after 17 years' service in the famous Strassburg school under De Bary and Graf zu Solms-Laubach.

MR. E. CHAPMAN, who has for many years been science tutor at Magdalen College, Oxford, is leaving Oxford at the end of the summer term. Mr. R. T. Günther has been appointed his successor.

THE Linacre Professor of Comparative Anatomy in the University of Oxford, E. Ray Lankester, is republishing in one volume various studies made in the Morphological Laboratory since his election to the Professorship. We sincerely trust that the original place of publication and the original pagination of these papers will be fully quoted; otherwise the volume will please few people besides the Professor and his pupils. Professor Lankester has recently been removing a quantity of worthless stuffed specimens from the court of the Oxford Museum, with the intention of replacing them by decent specimens and anatomical preparations so arranged and labelled as to afford as much information as possible. This is only a continuation of many valuable improvements that the Linacre Professor has carried out during the last three years. When are similar improvements to be continued in the zoological galleries of our national museum?

THERE is now a Psycho-physical laboratory at Cambridge, and Dr. W. H. Rivers of St. John's College, is conducting practical work this term.

AT Cambridge University an important proposal has been made by the Council of the Senate, to establish two new degrees, Bachelor of Science and Bachelor of Letters, which may be conferred upon graduates of any recognised University. The conditions suggested are—matriculation; residence for three terms, the prosecution of advanced study in Cambridge; an original dissertation on some subject, literary or scientific, coming under the cognisance of one of the Special Boards of Studies. This lead is pretty certain to be followed by Oxford, where similar ideas have been in the air for some time. The scheme, if confirmed, will prove of great advantage to the Universities themselves, and to the advanced students who will then be attracted thither.

THE Library of the late Professor Milnes Marshall has been generously presented to Owens College, by his friends and executors. A committee has been appointed to establish some memorial of his work, and it is thought likely that some definite scheme for the keeping up of the library will be proposed.

THE Professorship of Zoology at the Owens College, Manchester, vacant through the death of Professor Marshall, has now been advertised. The income is calculated to amount to £750 per annum, and consists of a fixed stipend of £300, a fee of £50 for services rendered to the Museum, and various capitation fees. The Professor is required to instruct in Biology (Physiological and Zoological portion) and Zoology, including Comparative Embryology; to take charge of the Laboratory; to conduct certain special classes for teachers; to give scientific aid in the arrangement of the Zoological part of the Museum; and to deliver annually a short course of museum lectures or public demonstrations. Further, as he becomes a member of the Senate, he has certain duties to discharge in the College and in the Victoria University. He has two demonstrators to assist him in his work. Applications must be made to the Registrar, not later than April 3.

PROFESSOR ALEXANDER, who has succeeded Professor Adamson in the chair of Mental Philosophy at Owens College, Manchester, intends to offer opportunities for laboratory work in physiological psychology. Professor Alexander has been engaged in experimental work in Dr. Burdon Sanderson's laboratory at Oxford for a considerable time.

EDINBURGH University is about to add to its possessions M'Ewan Hall, built at a cost of more than £50,000, for graduation and other ceremonies; University Hall, erected through the efforts of Professor Patrick Geddes, as a hall of residence for men students; Masson Hall, about to be erected as a hall of residence for women students; a field near Corstorphine, purchased for £9,000, and fitted out at a cost of

£3,000 more, for athletic sports; and a chair of Public Health, for endowing which the late Mr. A. L. Bruce has left £5,000.

THE Milroy Lecturer to the Royal College of Physicians this year was Dr. J. Berry Haycraft. His lectures on "Weismannism, Disease, and Race Progress" were given in the Examination Hall at the Savoy on February 15, 20, and 22.

AT the annual meeting of the Board of Regents of the Smithsonian Institution, the secretary presented his annual report with a few remarks upon the enlarged activities of the Institution, referring especially to the work in physical science and to the increased number of correspondents of the Institution, now numbering about 24,000, more than half of them being without the United States, and scattered over the whole globe.

THE Ohio Academy of Science is organising a Natural History Survey of the State. Professors Claypole, Kellerman, and Kellicott have been appointed directors, their duty being to enlist and organise volunteers, to direct them in the choice of fields, and to aid them in the prosecution of their labours. Each worker will, however, independently present his results to the Academy, and be himself responsible for them.

A FREE course of lectures on General Archæology, entitled "Man before History," has been delivered by Dr. Daniel G. Brinton, at the Lecture Hall of the Academy of Natural Sciences of Philadelphia, during the winter session. "The Aims and Methods of Archæology" formed the subject of the first lecture; those of the second, third, fourth and fifth respectively were Africa, Asia, Europe, and America in the semi-historic and pre-historic periods; that of the sixth and final lecture, to be given on March 8, "The Island World in the Semi-historic and Pre-historic Periods," including geographical distribution. The detailed results of this suggestive series will, we trust, be eventually published in the same form as Dr. Brinton's previous course on "Races and Peoples."

THE Biological Station at Plon, which was started about a year ago for the special investigation of Fresh-water Biology, seems to be doing well. In the second part of its *Forschungsberichte* (Berlin, 1894), Dr. Zacharias gives a map of the East-Holstein fresh-water areas in the Plon district. Dr. W. Ule contributes a sketch of the geology of the district, and Dr. Krause a sketch of the botany. Graf Castracane and Professor Brun describe the diatomaceæ of the Plöner See, and Dr. Zacharias figures and describes ten new infusoria.

WE understand that "The British Institute of Preventive Medicine," to which we referred in our February number of last year, has acquired land for the erection of buildings close to Chelsea Bridge, from the Duke of Westminster. The committee have received £120,000 to enable them to carry out their scheme.

THE Woodwardian Museum, Cambridge, has recently been enriched by a large collection of fossils, mostly Cretaceous, the gift of the Rev. Professor T. Wiltshire.

THE Royal Botanic Society (London) is appealing to Government for a grant towards the support of their gardens in Regent's Park. The Society has done good work in the past in affording help, in the form of living specimens, to botanical students in the medical, pharmaceutical, and veterinary schools of the metropolis. We can ill afford to lose such institutions as the Regent's Park Garden or the Apothecaries' Garden at Chelsea; at the same time, they should be made as available as possible for the use of the interested public. There has been no doubt

a certain exclusiveness towards the public on the part of the Fellows of the Society now in question; and a Society which asks for public money and occupies a large space in a public park must afford simpler means of entrance to their domain than an order from a Fellow. A small fee for admission, following the example of their neighbours at the Zoological Gardens, would give people generally the opportunity they have a right to ask, and at the same time help to make up the £8,000 deficiency which the Fellows of the Society have now to meet.

THE Scottish Geographical Society has appointed a committee, consisting of Dr. John Murray, Professor James Geikie, Dr. Buchan, and Mr. J. G. Bartholomew, together with delegates from other scientific societies, to take steps towards the promotion of Antarctic exploration, and the *Scottish Geographical Magazine* for February contains two communications on the subject. In the first Mr. William S. Bruce, naturalist to the s.s. "Balæna," gives a short account of previous explorations; in the second Dr. C. W. Donald describes the Dundee Whaling Expedition of the summer of 1892-3. A landing was effected on the beach in the north-west of the Erebus and Terror Gulf, and the authorities all agreed that a party could spend a comfortable winter in such a spot as this. Dr. Donald ascertained also that it would be comparatively easy to reach the surface of the ice-cap from many of the landing-places in sight, on Louis Philippe Land as well as on Joinville Island. The finding of a practicable wintering place from which the surface of the ice-sheet would be accessible is an important advance in our knowledge, for abrupt cliffs of rock or ice, bound most other parts of the Antarctic continent. There are numerous notes on the character of the ice, and some illustrations; but little could be added during an expedition of this sort to our knowledge of the fauna and flora of the parts visited, and the notes made naturally refer mainly to the whales and seals. Among the birds only one not aquatic, the common hooded crow, was seen. The plants were all mosses and seaweeds. Some fossils are mentioned as having been obtained from Seymour Island, but it is not stated what they are. We believe, however, that land or fresh-water species are still quite unknown from the Antarctic regions, either living or in a fossil state, except the few cryptogams found on different occasions. If the Scottish Geographical Society continue their efforts, we may expect before long to learn something more about this mysterious land, and may ascertain whether it ever supported a fauna and flora as peculiar as that of the similarly isolated continent of Australia.

DR. HENRY WOODWARD, F.R.S., is the new President of the Geological Society of London, Mr. Richard Lydekker becomes a Vice-President, and Dr. J. Walter Gregory forms the new blood in the Council. The election took place on February 16, when the retiring president, Mr. W. H. Hudleston, F.R.S., read his address "On some recent work of the Geological Society," being a continuation of the subject dealt with by him on the occasion of the last annual meeting. The fellows and their friends dined together at the Criterion the same evening. The more reasonable charge of half-a-guinea for dinner tickets, initiated by Dr. Woodward, resulted in a better and more representative attendance. Speeches were made by Sir Douglas Galton, Sir Charles Wilson, Sir W. Flower, Sir Archibald Geikie, Dr. Hinde, Dr. Hicks, Dr. Woodward, Lieutenant-General McMahon, Mr. J. E. Marr, and others.

LIEUTENANT-GENERAL C. A. MCMAHON was elected President of the Geologists' Association (London) at the Annual General Meeting held on February 2. The retiring President, Mr. Horace B. Woodward, read an address "On Geology in the Field and in the Study," which will be printed in the "Proceedings."

A FEW months ago Mr. James H. Veitch exhibited before the fellows of the Linnean Society a number of interesting objects collected during his recent travels in Japan. He has now presented his extensive and varied collection to the Museum

of the Royal Gardens at Kew, and the January number of the *Kew Bulletin* supplies a few notes on some of the products, many of which are quite new to the Museum.

THE Eastbourne Natural History Society has issued its *Transactions* for the Session 1892–3. Among the various papers on subjects of such world-wide importance as are usually affected by our local societies, we note a list of the Marine Polyzoa of Eastbourne, by Dr. H. S. Gabbett, and some interesting notes by Mr. H. Michell-Whitley, the president, on recent archæological finds in the Eastbourne district. The Society numbers 62 members, including the Right Hon. T. H. Huxley.

THE Royal Zoological Society of Dublin has recently acquired by purchase a jaguar, a hairy tapir, a golden agouti, three tree ducks, two curassows, four crested quails, and two black parrots.

THE Geological Society of America held its sixth annual meeting at the end of December last, in Boston and Cambridge, Mass., under the Presidency of Sir J. W. Dawson. In his presidential address, Sir William discussed recent geological problems, especially those connected with pre-Cambrian rocks, mountain formation, the Glacial period, and the Deluge. Abstracts of many of the papers read will be found in the February number of *The American Geologist*. The next winter meeting is to be at Baltimore, when Professor T. C. Chamberlin will preside. We are informed that at the annual dinner "there was a continual flow of wit and good humour." This is probably to be accounted for by the fact that the remarks made by the fellows present were "brief."

AT the annual meeting of the Biological Society of Washington, the President, Professor C. V. Riley, entomologist of the U.S. Department of Agriculture, delivered an address on the Social Insects. "The instinctive and inevitable actions of insects are," he said, "associated with many others, which result from the possession of intelligence, of conscious reasoning, and reflective powers."

PARTICULARS of the sixth Geological Congress, which will be held at Zürich from August 20 to September 2, are to hand. The subscription will be twenty-five francs (£1), and should be sent to M. C. Escher-Hess, Bahnhofstrasse, Zürich. The Excursions are numerous and comprehensive, and for the convenience of our readers we append a brief list.

Those arranged before the session commences are as follow:—August 22 to 27, under the direction of M. Schardt—Geneva to Bellegarde; Châtillon-de-Michaille to Nantua; Charrix to Chesery; to Thoiry; to Gex; to Geneva (cost 50 frs.). August 23 to 27, under M. Jaccard—Portarlier to Vallorbes; to Yverdon; to Fleurier; to Neuchâtel; to Locle (cost 50 frs.). August 22 to 27, under M. Rollier—Porrentruy to Delemont (3 days in this district); to Saignelégier; to St. Imier; to Bienne (cost 60 frs.). August 22 to 26, under M Schmidt—Wiesenthal to Bâle (2 days); to Laufenberg; to Brugg; to Zürich (cost 60 frs.). August 24 to 28, under M. Mühlberg —Staffelegg to Olten; to Kirchzimmer; to Reigoldswil; to Aarau; to Zürich (cost 50 frs.).

Those arranged after the session:—September 3 to 13, under M. Heim—Zürich to Weissbad; Säntis; Amden; Obstalden; Linthal; Elm; Flims; Tenigerbad; Olivone; Bernardino; Lugano (cost 200 frs.). September 3 to 14, under M. Schmidt —Zürich to Schwytz; Wasen; Hospenthal; Ulrichen; Airolo; Fusio; Faido; Lugano (250 frs.). September 3 to 10, under M. Baltzer—Zürich to Innertkirchen; Gstellihorn; Guttannen; Hospice Grimsel; Hospenthal; Airolo; Lugano. September 3 to 15, under M. Schardt—Bulle to Albeuve; Rougemont; Châlet du Gros Jable; Ormont; Bex; Champéry; Sanlanfe; Tête-Noire; Champex; Bagnes Brigue; Domo d'Ossola; Lugano (150 frs.). Several other excursions have been

arranged, but full particulars of each and every excursion can be obtained from M. le Prof. E. Renevier, Lausanne, or MM. Ruffieux et Ruchonnet, Agence Suisse de Voyages, Lausanne.

THE Oxford University Junior Scientific Club announce that they will hold a conversazione at the University Museum on May 22, and that Professor Macalister of Cambridge will deliver the third "Robert Boyle Lecture" on 4th or 8th May, his subject being "Some Morphological Lessons taught by Human Variations." At the meeting of the Club on February 16, papers were read by Mr. M. S. Pembrey, on "Histology of Organs after Extirpation of the Thyroid Gland"; and Mr. F. Druce, on "Some Characteristics of Cyclonic Storms."

A LARGE quantity of natural history material, which was exhibited at Chicago, has been purchased on behalf of the city of Philadelphia, and it is proposed to erect a fresh building for its accommodation, instead of incorporating it with collections already in existence.

THE Crystal Palace has fallen from its high estate, and is associated in the minds of most people with no other science than that of pyrotechny. Still, however, it does something for the cause of natural history, and we learn from the report of the directors of the company that £300 *per annum* is spent on the natural history department, while £800 goes to the attendants in the Aquarium, and as food for fishes.

THE HAECKEL CELEBRATION (Special Account).

ON the 16th of February Ernst Haeckel completed the sixtieth year of his life. On the 17th, the little town of Jena, in whose University Haeckel is Professor of Zoology, was thronged by a great crowd of his friends, pupils and admirers, among whom may be specially mentioned the Hertwigs (Oscar and Richard), Waldeyer, Arnold Lang and Hermann Credner, besides many well known professors of Jena itself. The chief ceremony of the day was the uncovering of the marble bust of the great scientific worker and writer, from the chisel of the eminent sculptor, Professor Kopf, of Rome. At noon the lecture-theatre of the Zoological Institute, in which the greater part of Haeckel's life-work has been carried on, was crammed from floor to ceiling, and Professor R. Hertwig, of Munich, the pupil, friend and colleague of Haeckel, was called upon to unveil the bust. In an admirably-worded speech he alluded to the main facts of Haeckel's life, and especially to his labours in the cause of science and scientific freedom; of these facts we give a short account below. The unveiling of the striking bust was the signal for a great outburst of applause, and when this had subsided, a deputation from some societies, the Medicinish-Naturwissenschaftliche Gesellschaft of Jena and the Geographische Gesellschaft of Thüringen, offered to Professor Haeckel their honorary membership. They were followed by a deputation from the students, who expressed in enthusiastic terms their admiration and respect for the Professor of Zoology. Professor Max Fürbringer of Jena followed with details concerning the subscription to the bust, informing us that there had been nearly 700 subscribers, who sent their tokens of appreciation from all parts of the world; he especially alluded to the gratifying fact that many subscriptions had come from France. As a consequence of this, the total amount exceeded the cost of the bust by at least £300, and this sum he had pleasure in placing in the hands of Professor Haeckel, for him to devote to such purpose as he might think best in the interests of science.

After the ceremony, and after Professor Haeckel had, not without emotion, acknowledged the honours showered upon him, the elect among the visitors adjourned to a banquet in the Hotel zum Bären, where covers were laid for about 120 of both sexes. The day concluded with that characteristic German institution, a "Commers," in which almost all the students of Jena seemed to be taking part. Cheers for the Professor, songs and speeches in his honour, mingled with the clinking of glasses, enlivened the old University till a late hour of the night.

Ernst Haeckel, the second son of Ober-regierungsrath Carl Haeckel, was born in Potsdam on February 16, 1834. He was early led to the study of nature, especially of Botany, an inclination nourished by his mother, who came of the old legal family of Sethe, and by his father, who himself took a keen interest in Geography, and numbered among his friends the geographer Ritter and the African traveller Barth. He went to school at Merseburg, whither his father had removed, and continued his studies in natural science. At his father's instance, however, he decided on medicine rather than pure science, as affording a surer means of livelihood; at the same time he hoped to travel as a ship's doctor, and so to see distant lands. At the age of eighteen, then, he began his medical studies in Berlin, but seems to have been mostly attracted by the lectures of the botanist, Alexander Braun. From the autumn of 1852 till Easter of 1854 he attended the anatomical lectures of Kölliker and Leydig in Würzburg, where he made friends with Gegenbaur and the present Berlin physician, Gerhardt. Returning to Berlin, he went to the lectures of Johannes Müller, which greatly influenced him and determined the future course of his life. In his enthusiasm he spent all his spare time in natural history excursions in the neighbourhood, holding entirely aloof from the beer-drinking entertainments of his fellow-students. Autumn of 1854 saw him with Johannes Müller in Heligoland, where he obtained his first impression of the sea and of the pelagic fauna, from which sprung his predilection for researches on the "plankton" or floating tribes of the sea. While at Berlin, Haeckel made friends with Max Schultze, Claparède, von Richthofen, von Martens and others who have since attained to eminence. At Easter, 1855, he returned to the then famous medical school of Würzburg, where, in the summer of the following year he became assistant to Virchow, in whose *Archiv* he published one of his first independent works,—"Ueber die Plexus chorioides." In the autumn of 1856, together with Müller and Kölliker he visited the sea-fisheries of Nice, where he made his first acquaintance with the Radiolaria, and discovered the movement of cells in the connective tissue of Tunicates. His medical studies in Berlin were then resumed, and in March, 1857, he took his degree of Doctor of Medicine, presenting before Ehrenberg his Thesis "On the Tissues of the Crayfish." A summer in Vienna was divided between medical work and excursions in company with the botanist Focke from Bremen and the zoologist Krabbe from Copenhagen. Although in the following winter he passed the State Medical examination in Berlin, yet, at the instance of Johannes Müller, he determined henceforward to devote himself to Zoology. Unfortunately, his intention of working under Müller was thwarted by the sudden death of the latter at Easter, 1858. In 1859 he went to Italy and again studied the pelagic fauna of the Mediterranean, collecting materials for his Monograph on the Radiolaria, which appeared in 1862. At the suggestion of Gegenbaur, in 1861, he settled in Jena, where he was soon elected Professor of Zoology. In this quiet little town, amid beautiful and natural surroundings, he has stayed ever since, resisting pressing invitations to go to the larger Universities of Würzburg, Bonn, Vienna, and Strassburg.

A change now came. After a year and a half of happy married life, his wife, who was his cousin, Anna Sethe, died, and Haeckel drowned his sorrow in the most intense work. Darwin's "Origin of Species," which had appeared a few years before, had made a great impression on him. This he had already acknowledged in his Radiolarian monograph, and now he set about his important work "Generelle Morphologie," which appeared in 1866, and was the first book to view the animal kingdom in its entirety from the standpoint of the dual doctrine of descent and natural selection. This work completed, Haeckel went on a holiday to the Canary Islands, of which we have an account in his "Besteigung des Pic von Teneriffa.' On his return through London he met Huxley, Lyell, and Darwin himself.

In 1868 appeared another book inspired by Darwinism, his "Natürliche Schöpfungsgeschichte," which in 1889 had reached its eighth edition, and been translated into twelve languages, including Malay and Japanese. This result was not, however, attained without gaining for the author many enemies, and converting several warm admirers into hot opponents. From these general works he turned again to mono-

graphs on particular groups, the Development of Siphonophora (1869), Studies on Monera and other Protista (1870), Monograph of the Calcareous Sponges (1872). The material for the latter work had been collected on excursions to Norway and Dalmatia, and in it is first found the Gastræa Theory, subsequently elaborated by him; according to which all many-celled animals are derived from and pass through in their development a primitive sac-like form, the Gastrula. In 1874 was published his "Anthropogenie," a popular exposition of the evolution of animals leading up to man. About this time Haeckel travelled a good deal; in 1873 to the Red Sea in 1875 to Corsica, and in 1877 to Corfu. In 1876 appeared his important paper on the Perigenesis of the Plastidule. In 1877 he delivered his address before the gathering of Naturalists in Munich, on the modern theory of development in its relation to general science. This produced a reply from Virchow which Haeckel answered in his pamphlet "Free Knowledge and Free Teaching," where he adopted as his motto, "Impavidi progrediamus." In 1881 appeared his Monograph of the Medusæ, and this was followed by a journey to Ceylon, which gave rise to his charming "Indische Reise-briefe." After this Haeckel came into closer connection with English scientific men, by the publication of his magnificent 'Challenger" Reports on the Medusæ (1881); on the Radiolaria (1887); on the Siphonophora (1888), and on the Horny Sponges of the Deep Sea (1889). In 1890 he visited Algiers and Tunis, and in this year was published his "Plankton-Studien," which summed up his pelagic researches and stated his views as to the distribution of marine life in opposition to the views of Hensen and others. A continuation of these researches was made in 1892, around the Hebrides, in company with John Murray of the "Challenger," and in 1893, in the neighbourhood of Messina. Last year also he published his "Monism as a Link between Religion and Science."

It would be impossible here to enumerate the many eminent scientists who have been pupils of Haeckel, and who have raised the fame of the University of Jena. By his own fame, too, the University has been enriched, as in the case of the endowment of a Professorship and a travelling studentship by Dr. Paul von Ritter, and the bequest of the Countess Bose. Indeed his lucid and flowing style, his orderly and philosophic grasp of facts, have attracted many to his works who would otherwise have been repelled by their detail and technicality. In the broader aspects of his scientific work he has been as it were the complement of Darwin in the direction of Morphology and Embryology, somewhat as Herbert Spencer has been in Psychology and Sociology. His works are adorned by drawings from his own pencil, for he is an excellent draughtsman and water-colourist. Although sixty years of age, he has the strength, energy, and freshness of a much younger man, having been in earlier days a noted gymnast. In 1867 he took as his second wife the daughter of the anatomist Huschke, by whom he has one son and two daughters. Haeckel has never plunged far into the troublous sea of politics, but has reserved his energies for fighting his own battles, and they have not been few, and for advancing the standard of science, which he has done to no small extent.

IN connection with the P.N.E.U., the A.W.P.L. have arranged two courses of lectures on natural history and geology, which are being given at the British Museum (Natural History). The first course, on the Domesticated Animal, from which men were excluded, was delivered by Miss Goodrich Freer on Saturday afternoons during February. The place chosen for the lecture was that very popular gallery of the Geological Department of the British Museum in which the fossil Ammonites are exhibited.

The next course will be given by Miss Whitley on the mornings of March 2, 9, 14, and 16. The subject is Field Work in relation to Practical Geology, and the lecture hall is to be the adjoining public gallery of the same department (Members meet near the Mastodon). After one hour's talking, the lecturer will give demonstrations in the Museum, which, it is well known, contains a large number of exhibits relating to practical geology (or, are we confusing it with the other establishment at Jermyn Street?); anyway there are some fine blocks of fossiliferous stone on which the members can practise field work.

CORRESPONDENCE.

Scientific Volapük.

The following, written nearly seventy-five years ago by Thomas Jefferson, one of the signers of the Declaration of American Independence, and sometime President of the United States, seems rather to the point now that new words are so much to the front:—"I am a friend to *neology*. It is the only way to give to a language copiousness and euphony. Without it we should still be held to the vocabulary of Alfred or of Ulphilas, and held to their state of science also, for I am sure they had no words which could have conveyed the ideas of oxigen, cotyledons, zoophytes, magnetism, electricity, hyaline, and thousands of others expressing ideas not then existing, nor of possible communication in the state of their language. . . . . Dictionaries are but the depositaries of words already legitimated by usage. Society is the workshop in which new ones are elaborated. When an individual uses a new word, if ill formed, it is rejected in society; if well formed, adopted, and after due time laid up in the depositary of dictionaries. And if, in this process of sound neologisation, our trans-Atlantic brethren shall not choose to accompany us, we may furnish, after the Ionians, a second example of a colonial dialect improving on its primitive." — ("Correspondence of Thomas Jefferson," vol. iv., pp. 339, 340. Monticello, Aug. 15, 1820. Letter to John Adams.)

Nearly three-quarters of a century afterwards *our* American brethren still hold the lead. But words must not be condemned because they are new. Some of the new words, like "topotype" in your list, supply a decided want. New words again, are certainly preferable to old ones distorted. It must be easier for a beginner to learn a new word than to remember that "period" and "age" in a geological paper each mean very different things, according to whether they are in inverted commas or not, and in some cases they occur in the same page, each with their different meanings. "Age" has been strongly condemned by a President of the Geological Society in his address (W. T. Blanford, 1889, p. 37).

Another advantage of new words is that they often emphasise a distinction which is apt to be otherwise overlooked. It ought to be impossible for a warm discussion to arise betwen consentients, as I have seen, over a remark—"the older shells of —— are more plicate"; because one took "older" in a geological sense, another as referring to the age of the individual, a third to the age of the race. It is a climax of absurdity that the "older" shells geologically are the "younger" biologically. It suggests that geological strata should be called "earlier" and "later," never "older" and "younger"; but, again, "earlier" and "later" are used in an "evolutionary" (!) sense, and they are not necessarily equal to "primitive" and "more specialised."

S. S. Buckman.

Climatic Conditions and Life.

With reference to the remarks made on p. 89, no. 24, of Natural Science (Feb., 1893), regarding a suggestion of mine as to former climatic conditions—

I.—May I be permitted to point out that so far as I know there is no *limit* to the extent of the areas over which these phenomena (fumaroles or hot-springs) might be manifested.

A whole continent might, in former times, have been covered with them and the

character of its vegetation and animal life determined by them—though it was set itself in a frozen sea. Such an extreme case is, I think, a possibility.

In India where we have flows of trap or lava, altogether covering an area of 200,000 square miles, we learn to look at such questions from a somewhat liberal scale of measurement.

II.—Chemical deposits are by no means invariably formed by hot springs. And even in those cases where they are formed they are not always of so stable a character as to leave permanent traces.

Still it may be the case that beds of limestone occurring in association with such fossils as I have referred to may really have been derived from the calcareous deposits (travertine) of hot springs.

III.—It is scarcely needful to add that fossil localities often occupy very narrow and restricted areas.

Science and Art Museum, Dublin, V. BALL.
February 12, 1894.

THE GEOLOGICAL SOCIETY'S JOURNAL.

IN the "News of Universities," NAT. SCI., vol. iii., p. 470, reference is made to the printing of the date of issue of scientific publications side by side with the signatures. Allow me to point out that the editor of the *Quarterly Journal of the Geological Society* has this year initiated an improvement even on this, the date of issue being printed at the top of every open two pages, half on each side of the fold. C. D. S.

Cephalaspis IN THE CAITHNESS FLAGS.

IN reference to the recent announcement of the discovery of the "typically Lower Devonian genus *Cephalaspis*" near Thurso (NAT. SCI., vol, iii., p. 255), it should be remembered that this fish occurs in the Upper Devonian of Scaumenac Bay, Canada (see *Geol. Mag.*, 1890, p. 15). We must not, therefore, be surprised to find it in the allied fauna of "Lake Orcady."

Junagadh, Kathiawad, India. J. W. EVANS.

TO CORRESPONDENTS.

REV. S. BARBER.—We are obliged for your communication. Meteorology does not especially concern us; but you will find a mention of the storm of July 8, 1893, on p. 395 of our third volume.

RECORDER.—The investments of the Geological Society of London for the past four years are:—£420 (1890); £506 (1891); £528 (1892); £502 (1893). The total value of the invested funds is, according to the latest balance-sheet of the Society, £10,729 11s.

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